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THE FRANKFORT-ON-THE-MAIN MUNICIPAL PLANT.

We print elsewhere an article on the new Frankfort municipal plant, from the pen of the constructing engineer, Herr Melms, which admirably presents the various engineering features of this fine installation. The most noteworthy points refer to the system of distribution, and the method of installing the conductors. As will be seen, the distributing cables are merely laid on a bed of sand in trenches under the sidewalks, and the transformer stations are placed in pits below the level of the streets. An interesting feature in connection with the pits is the provision made for ventilation, which is maintained through the heat generated by the transformers. The installation in all of its parts is alike creditable to the engineers who are responsible for its design, and to those who put it in execution, and presents many points well worthy of careful study by Americans, particularly on account of the entirely different practice involved from that followed in this country.

THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The convention of the Northwestern Electrical Association, held at Milwaukee last week, was another success scored for this vigorous organization. While the papers read did not, as a whole, equal the merit of those presented at the previous meeting, this was largely compensated for by the value of, and the interest taken in, the discussions. The commercial feature was again a notable one; by far the greatest value of the meeting of bodies of this character lies, perhaps, aside from the opportunity furnished to the members of comparing notes, in the occasion thus offered of becoming better acquainted with the latest advances in electrical manufactures. The advocacy of gas over the electric light in such a meeting was a decided novelty, but a good end will be served if the result of the discussion tends to cause the members to bring more forcibly before the public the incontestable superiority of the electric light over gas as an illuminant, basing their arguments more largely upon its merit in this respect, and leads them to pay more attention to the inadvisability of allowing lamps to be used beyond an age when their lighting efficiency has begun to materially decrease. The paper of Mr. Cole again brings out the absurdity of charging for the electric light by "flat" instead of meter rates; the former method has been so uniformly found to be disadvantageous, that it is surprising that some stations still adhere to it, particularly as experience has shown that the fear of loss of business through a change to meter rates is largely a chimerical one.

STORAGE BATTERIES IN POWER AND CENTRAL STATION WORK.

The paper read by Mr. G. Herbert Condict before the Northwestern Electrical Association, and printed elsewhere in this issue, brings out strikingly the services that may be rendered by storage batteries in connection with railway and lighting work. In the present instance an eminently unsatisfactory lighting and railway service was, by the aid of a storage battery, so improved as to render it not only entirely acceptable thenceforth to the public, but also, apparently, a source of greatly increased income to the operating company. It is true that the conditions were here exceptionally favorable to the employment of the storage battery, and that it is not probable there are many plants in existence so utterly bad in design that its aid will accomplish similarly great results. Nevertheless, the main principles that rendered its employment profitable in this instance exist to a greater or less extent in plants of good design; as, for example, the possibility, through its use of securing good regulation, and, above all, enabling the generating machinery to be operated at its greatest efficiency. At the present day, when the machinery of a generating station reaches the limit of its capacity at the time of heavy load, the owners should not even consider the advisability of purchasing additional machinery until they have

thoroughly investigated the question if the required capacity might not be much better procured through the addition of a storage battery. In laying out a new station it would now also be advisable to always take into consideration, among other designs, one including a storage battery, and then make a comparison between the different designs based upon both first cost and operation.

CHANGES IN THE HYSTERETIC QUALITIES OF IRON.

The columns of our English contemporary, *The Electrician*, have recently contained a number of articles on the question of the changes of the hysteretic quality of iron in transformers, attention being first directed to the subject by Mr. Partridge. Prof. Fleming, in a communication in a succeeding issue, advised caution in regard to accepting any hypothesis that transformer losses invariably increase with time. In the same number Mr. O. T. Blathy states that the fact of an increase of iron losses in transformers with time has been well recognized by manufacturers of transformers for years. Mr. Mordey throws the first full light on the subject, and states positively that the effect referred to is not fatigue of the iron caused by repeated magnetic reversals, but is due to a physical change resulting from long continued heating at a very moderate temperature, and is similar to that resulting through hammering, rolling or by heating to redness and cooling quickly. While the increase thus produced may be as high as 40 per cent., Mr. Mordey calls attention to the fact that this may amount to less than .4 per cent. decrease in the total efficiency of a transformer. In the current issue of the same journal Prof. Ewing gives the result of experiments showing that no change in the hysteretic quality of iron is produced by molecular fatigue through the material being subjected to long continued reversals, if the temperature of the iron experimented with is not permitted to appreciably increase. The conclusion to be drawn from this interesting discussion is that a very notable change in the hysteretic qualities of the iron of transformers does occur in practical use, but that this change is to be ascribed entirely to the effect on the iron of an increased temperature, and not to a molecular fatigue of the metal through the continued reversals of its magnetism.

NEW UNDERWRITERS' RULES.

The amendments made at the recent meeting of the Underwriters' National Electric Association to its code of insurance rules, which are referred to in detail elsewhere, are of considerable interest. One of the most important changes made is in regard to the allowable carrying capacity of conductors, which is increased for concealed work, and a new table added for open-work conductors. As the object to be attained in prescribing the limit of current for conductors of various sizes is to fix the limit of increase of temperature, it was manifestly absurd to class together confined conductors and those so exposed as to be under much more favorable conditions as regards the influence of cooling. As will be seen, the increase in the table for concealed work is considerable, that for No. 4 wire for instance, being increased from 50 to 63 amperes, and 92 amperes being allowed in open work with the same wire. It would be interesting to know upon what authority or experiments these changes are based. While we can see no doubt as to their advisability, yet we think it due to the electrical profession and in the interest of harmony, that any notable changes made in the rules affecting the electrical industry, whether favorable or unfavorable, should be accompanied by the underlying reasons for the same. Several of the other rules have been made more liberal and all of the amendments give evidence of the competency of the gentlemen comprising the National Electric Association to deal with the questions, coming within their province. An exception might be made in regard to the advisability of the prohibition in wiring of hard rubber for bushings, though even here, with modern methods of work, little or no hardship will result. While it is well for the association to take up the question of high potentials, they also did well to defer any action in the matter until the occasion arises. In Europe much harm has been done to the electrical industry through the formulation of rules based upon *a priori* considerations, and while the reverse method pursued in this country may at times have had unfavorable results, yet the wisdom of following and not preceding practice has been overwhelmingly established.

THE ELIHU THOMSON PRIZES.

The American electrical public has every reason to be gratified with the history of the Elihu Thomson prizes, recently awarded in Paris. The graceful act of Prof. Thomson in setting aside the 5,000 francs awarded to him in the international wattmeter competition, as a prize for a paper on theoretical electrical research, was a recognition of pure science that is only too rare on the part of those whose principal work has been in the practical branches, though in this case the donor is by no means a stranger in the former field. The generous addition of a second prize of 5,000 francs to be awarded to another paper commended by the committee of scientists having the matter in charge, was a further gage of the sincerity of Prof. Thomson's interest in the higher realms of electrical thought. The public confession thus made by Prof. Thomson of his devotion to the advancement of pure electrical science merely reveals to a wider circle what was previously known of the man and his work by those who had followed his career. In this connection we may state that a very eminent European savant, in reply to a question as to whom among Americans he ranked with the distinguished savants of Europe, named Elihu Thomson as one, the other three being Newcomb, Michelson and Rowland; he further remarked that while the work of Thomson had been principally confined to the practical field, yet when he did take up questions of pure science he showed a grasp of principles, a breadth of mind, and an originality of thought that easily ranked him with the class referred to. Another subject of congratulation in this connection is the fact that the prize in this international competition was carried off by an American, Dr. Webster of Clark University, and it is rather suggestive that the second prize was also awarded to an English speaking scientist, Prof. Oliver J. Lodge.

The Brooklyn Trolley Strike.

As we go to press the Brooklyn trolley strike does not seem any nearer a conclusion than at the beginning. The leading roads positively refuse to entertain any propositions from the strikers, and the latter persist in their opposition to the running of cars, and have finally induced the linemen to strike, thus still further complicating the situation. The companies affected have, through the aid of the police and the presence of the militia, the latter numbering over 7,000, been able to run some of their cars, but much difficulty seems to have been met in obtaining competent men, notwithstanding the protection offered. Considerable damage has been done by the strikers to the cars and lines, many wires having been cut during the nights. Much comment has been caused by the inability of the companies to run their cars with the protection afforded by the police and militia, and those favoring the strikers have advocated the city authorities taking charge of the roads in consequence. President Norton, of the Atlantic Avenue road, states that the situation is at present becoming more favorable, and he expects within a few days to have all of his cars running. One of the New York dailies editorially maintains, however, that the companies have been able to procure only 500 men to take the places of 5,000 strikers.

The National Electric Light Association.

The Trunk Line Association has granted a rate of a fare and a third for the round trip, on the certificate plan, for members and delegates attending the Convention of the National Electric Light Association, to be held in Cleveland, O., February 19, 20 and 21. Negotiations are now pending for a special train from New York to Cleveland, notice of which will be given as soon as the route is selected and schedule arranged.

Municipal Electric Lighting in Massachusetts.

The report for 1894 of the Gas and Electric Light Commissioners of the State of Massachusetts states that there are now municipal electric lighting plants in Braintree, Danvers, Hingham, Hull, Marblehead, Middleboro, Needham, North Attleboro, Peabody, Reading, Wakefield and Wellesley. Of these Middleboro and Wakefield have only plants for supplying both gas and electricity. The others supply only electricity. Danvers, Needham and Wellesley do no commercial business, and the two last named purchase from private companies.

The Meeting of the American Institute of Electrical Engineers.

The 93d meeting of the Institute was held on Wednesday evening, January 16, with President Houston in the chair.

Prof. Alexander Macfarlane read a paper on "The Units of Light and Radiation," in which, after discussing the various propositions put forth in this connection, several suggestions are made in regard to nomenclature. Prof. Macfarlane states that the difficulty that exists in expressing the unit of candle or other spherical source arises from the want of a name for the unit of solid angle, and for this he proposes a new word, *steradian*. In the paper nine different ideas are distinguished in connection with the general subject of radiation; six of these are the same as those recently advanced by Prof. Blondel, the additions being the introduction of an idea for the strength of the source of light, the intensity of a cylindrical source, and the intensity of a plane source.

Prof. Macfarlane criticises the use of the heavy Gothic symbols proposed by M. Hospitalier for a system of light units; in the system of symbols and abbreviations recommended by the Chicago Congress, he says all quantities are denoted by oblique or script letters, and the units and abbreviations for units by perpendicular letters. The proposed symbols, from their perpendicular character, will not harmonize with the other symbols of quantity, and they are besides already used to denote vector quantities. The discussion which followed was participated in by Messrs. Kennelly, Walcott and Burnett, and it was finally voted to refer the paper to the Committee on Units and Standards for consideration.

A paper was then read by Alton D Adams, on the "Best Material for Field Magnet Frames," which is reprinted elsewhere. Part in the discussion which followed was taken by Messrs. Crocker, Sheldon, Burke, Waldo, Rich, Fleming, W. L. Bliss and Gano S. Dunn. The consensus of opinion was that wrought iron did not have the advantages over cast steel for use in magnet frames that was claimed by the author.

Electrical Patent Record of the Past Year.

BY C. W. SWOOPE.

The volume of business transacted at the Patent Office seems to vary directly with the financial condition of the country, and may, therefore, be considered as a fair indication of its prosperity. The number of patents issued by the Patent Office up to January, 1895, was 531,618, of which nearly 20,000 were issued in 1894, as compared with 22,000 for the preceding year, or 162,000 for the five preceding years.

During the past year 1,600 patents, or 8 per cent. of the whole number issued, were for electrical inventions, which is 1,000 less than the preceding year, although the percentage in the former is as great, notwithstanding the corresponding decrease; thus really indicating an increase over 1893. To illustrate the distribution of patents over the electrical field as well as to indicate the amount of attention being bestowed upon any particular subject, the following statistics have been carefully compiled from the "Illustrated Record of Electrical Patents," as published each week by THE ELECTRICAL WORLD:

Electric Traction.

Electric railway systems and conduits	102	
Trolley and car appliances	113	
Electric locomotives	18	
		233
Dynamos and parts thereof		110
Motors and parts thereof		76
Regulators and current controlling apparatus		139
Transformers		23
Cut-outs and circuit breakers		33
Arc lamps		82
Incandescent lamps		33
Systems of electrical distribution		45
Switchboards		21
Switches		65
Wires, cables and conduits		44
Insulators and insulation		52
Electric measuring instruments, meters, indicators, etc		66
Telephones		97
Telegraph		43
Signal systems		110
Bells, annunciators, gas lighting, clocks, etc		103
Batteries—		
Primary	39	
Secondary	34	
		73
Electric heating and appliances		25
Electric welding		7
Electric mining		12
Medical apparatus		11
Cranes, hoists, etc		23
Miscellaneous		89
Total		1,615

Electric traction claims the greatest share of attention from inventors; of these patents only 3 per cent. were issued to foreign residents as compared with 9 per cent. the previous year.*

Current regulating and controlling devices, as well as signal systems, appear to be engaging particular attention. Of the whole number of patents granted during the year only 6 per cent. were issued to foreign residents.

The Elihu Thomson Prize in France.

It will be remembered by our readers that the Thomson wattmeter was awarded a first prize of 5,000 francs in the international competition of wattmeters held in Paris, France, several years ago, and that Prof. Elihu Thomson very generously set this amount aside to be offered as a prize to the best paper submitted dealing with a theoretical question connected with electrical science.

Four papers were submitted in the competition thus opened, one written in German, another in French, and two in English. A committee of distinguished French scientists and electricians, which included Mascart and Hospitalier, were named to award the prize. They reported that one of the papers, that in German, did not conform with the terms of the programme, and that a second, written in French, on dielectric hysteresis, while containing some very interesting matter, did not throw any new light on the subject. The third and fourth papers are on electrical oscillations, and the one to which the prize was awarded is entitled, "An Experimental Determination of the Period of Electric Oscillations," written by Dr. A. Webster, of Clark University, Worcester, Mass. The committee reported that the subject of oscillations in this paper is presented after a method new in its details, which permitted the author to measure periods of some hundred thousandths to the second; and that the influence of the principal cause of errors seems very slight, although there remain some doubts as to the inherent capacity of the self-inductance coil used

The final conclusions of the committee are as follows: "The committee consider that paper No. 4 (by Dr. Webster) is worthy to receive the prize established by Professor Thomson, and hope that this award will encourage the author to continue his excellent researches. The committee regret, however, not having at their disposal a second prize of equal value which they could grant to the author of paper No. 3." The paper thus referred to is by Dr. Oliver J. Lodge, and is devoted to a verification of the formula giving the period of oscillatory discharges of a condenser; this is pronounced by the committee an extensive study, in which the author has sought by means of elaborate calculations to evaluate all the inherent corrections necessary in the employment of the method.

Professor Elihu Thomson very generously met the wishes of the committee in this respect, and placed at their disposal a second sum of 5,000 francs, which was then awarded to Dr. Lodge.

New Underwriters' Rules.

At the recent meeting of the Underwriters' National Electric Association a number of changes were made in the rules of that association. The rule relating to lightning arresters has an addition to the effect that the wires for the two separate earths required must be run as nearly as possible in a straight line from the arresters to the earth connection. The rule relating to motors has been changed so that single pole switches may be used on motors of ¼ hp or less on low tension circuits. The rules relating to interior wiring are altered so as to no longer permit the use of hard rubber tubing for bushings, and to prohibit the use of snap switches on high potential circuits. A new section is added to the rules covering the use of arc lamps, requiring that where hanger boards are not used lamps must be hung on insulated supports other than their conductors. A new section is also added to the general rules for inside wiring requiring that conductors must be so spliced or joined as to be both mechanically and electrically secure without solder; after which they may be soldered to insure preservation and covered with an insulation equal to that on the conductors.

A special rule for inside wiring has been added, specifying that when from the nature of the case it is impossible to place insulated wire in non-combustible supports of glass or porcelain, the wires may be fished on the loop system if enclosed throughout in approved continuous flexible tubing or conduit. The section relating to double pole safety cut-outs is amended so as to require only the maximum safe carrying capacity to be stamped on them, and not also the carrying capacity at which they are to be used. A new rule has been added prohibiting the use of series incandescent lamps for decorative purposes inside of buildings.

* See THE ELECTRICAL WORLD, February 3, 1894.

A resolution was passed requiring each inspector to make tests within his territory in regard to the subject of electrolysis of underground pipes from trolley currents. Another resolution was passed calling the attention of the various underwriters' organizations and of companies maintaining overhead wires to the necessity for the enforcement of the rule in regard to the testing of wiring of buildings as to their freedom from grounds and compliance with Rule 44 in regard to the insulation resistance of installations.

The question of transformers was considered with respect to limiting the potential of the primary wires, and the advisability of requiring step-down transformers for this purpose; the matter was referred to a sub-committee for report.

The grounded neutral of the three-wire system is the subject of another resolution in which it is declared that the practice of grounding the Edison tube system is a constant menace to the properties lighted thereby, and the practice followed by some Edison stations of blowing out or burning out grounds occurring either on the positive or negative sides of the underground system is pronounced extremely dangerous, and evincing a wanton disregard for the safety of property interests.

In the report of the meeting attention is called to the rule adopted at Chicago in regard to high and low potential systems. This specifies that any circuit attached to a source of over 300 volts difference of potential between any two wires shall be considered as a high potential circuit, and coming under that class, unless an improved transformer device is used which cuts the potential difference down to less than 300 volts. This requires that the systems coming under the above description should be installed under the rules for series arc systems, and it applies to three or five-wire systems with a greater difference of potential than 300 volts.

The rule in regard to the carrying capacity of wires is amended, and the following two tables substituted for the single table heretofore given:

	Table A. Concealed Work.	Table B. Open Work.
B. & S. G.	Amperes.	Amperes.
0000	218	312
000	181	262
00	150	220
0	125	185
1	105	156
2	88	131
3	75	110
4	63	92
5	53	77
6	45	65
8	33	46
10	25	32
12	17	23
14	12	16
16	6	8
18	3	5

By open work is meant a construction which permits of all parts of the surface of insulating covering of wire being surrounded by free air. The carrying capacity of 16 and 18 wires is given, but no smaller wire than 14 is to be used except in interior conduits and in fixture work.

The Best Metal for Field Magnet Frames.*

BY ALTON D. ADAMS.

Cast iron, cast steel and wrought iron being the materials at our command for field magnet construction, it is an important question to the engineer and manufacturer which will produce a dynamo of given capacity, speed, efficiency and working qualities at the least cost.

I am not aware that any of the works on dynamo construction attempt a definite answer to this question, and the practice of builders is by no means uniform. Economical points of saturation requiring about the same magnetizing force per unit of length in each metal, are for cast iron a little under 40,000, cast-steel 70,000 to 80,000, and wrought iron about 90,000 lines per square inch.

The cost of cast steel is fully equal to that of forgings in simple shapes, and as it lies between cast and wrought iron in magnetic qualities, the cost of machines made with it will be between those of cast and wrought iron. A comparison will, therefore, be made between the cost of the latter two.

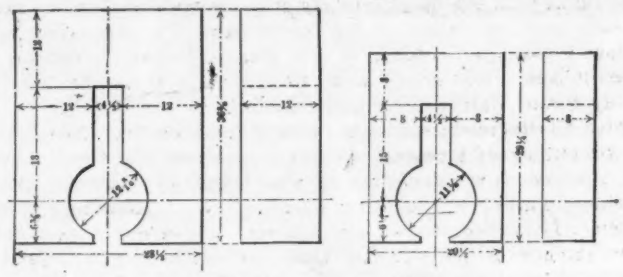
To be fairly compared, machines of different materials must be equal as to magnetic flux in field and armature cores, ampere-turns on armatures, field ampere-turns required in air gaps and as nearly as possible in magnet frames, watts used in windings, and be of the same capacities and speeds.

Taking wrought iron at a saturation of 90,000 and cast at 40,000 lines per square inch, the section of an equivalent cast will be two and one-quarter times that of wrought frame, and as the length of the cast-iron frame must be a little greater to give enough winding length, its weight will be about two and one-half times the wrought. A saving is thus at once made in favor of the wrought magnet, as forgings can be had per pound for much less than two and one-half times the cost of cast iron.

The same number of ampere turns and watts being required for the coils of the cast as the wrought iron magnet, and the weight of wire varying as the square of its length, the coils for the cast-iron frame will be much heavier. The armature core may have the same diameter in each frame, but must be longer in the cast frame so as to come under the pole pieces, thus materially increasing its weight.

As for the same resistance, the weight of armature winding increases as the square of its length, considerable more wire is required for the armature core of the cast-iron machine. In addition, the purely mechanical parts, shaft and base must be larger and more costly in the cast-iron machine because of the greater weights they have to carry.

To illustrate the difference in cost of construction, the following data of two machines is presented, each having capacity of 25 kw



Field Magnet Frames.

of 1,275 revolutions per minute, the same winding losses, the same ampere turns on armatures and field ampere turns in air gaps equal to about twice the armature ampere turns active at the pole corners.

The air gaps and armature cores of each machine are crossed by 4,320,000 webers, and allowing a leakage of 5 per cent. the field core must furnish 5,760,000 webers.

A wrought-iron field to carry 5,760,000 webers, at 90,000 per inch saturation, requires a section of 64 square inches, which is provided by a core of 8 inches square and a cast-iron field at 40,000 lines per square inch requires a section of 144 square inches provided by a core 12 inches square.

Allowing sufficient length for magnet windings the same air gap resistance and an armature core of 11 inches diameter for each of these frames, their dimensions will correspond to the following drawings:

The weights of these frames are

Wrought-iron frame	1,020 lbs.
Cast-iron frame	2,730 "

For work as shunt motors the wrought-iron machine requires 11,000 ampere turns in the air gaps and 2,000 in iron, the cast machine 11,000 ampere turns in air gaps and 3,800 in iron.

With 440 watts expended in field coils of each machine, an average length per turn of 38 inches in the coils for wrought iron and 54 inches in the coils for cast iron, the weights of these coils are

Wrought-iron machine	133 lbs. copper.
Cast-iron machine	340 " "

The drum armature for the wrought frame is 11 inches diameter and 8 inches long, that for the cast frame 11 inches diameter and 12 inches long, without allowance for shaft hole.

The weights for armatures are

Wrought-iron machine	211 lbs. discs.
Cast-iron machine	316 " "

With a loss at full load of 490 watts in the armature winding for wrought-iron machine, and 464 watts in the armature winding for cast-iron machine, these windings require in

Wrought-iron machine	49 lbs. copper.
Cast-iron machine	71 " "

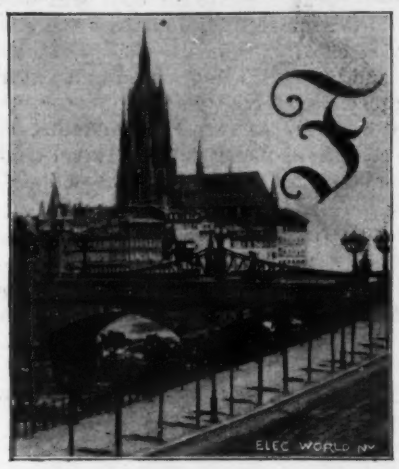
The above indicates plainly the great saving of wrought over cast iron in dynamo construction.

From the users' standpoint the wrought-iron machine seems preferable on account of its lesser weight and bulk, this difference being especially marked in machines for direct connection to engines, and other purposes where slow speed is necessary.

* A paper read before the American Institute of Electrical Engineers, January 10, 1895.

The Frankfort-on-the-Main Municipal Light and Power Plant.

BY G. J. MELMS.



FRANKFORT-ON-THE-MAIN is a very old city. It was a Roman military station, an important city during the middle ages, and has become in modern times one of the rich commercial cities of continental Europe, and at present is one of the money centres of Germany. Thanks to the excellent municipal government, Frankfort has also become in the course of time one of the handsomest cities in Germany. Its wide and well paved streets, its water and sewerage systems, its modern public buildings, parks, the famous Palmen-garten, the monumental Grand Opera House, the Central Railway station, all tend to give this city a metropolitan air. But with all its modern improvements Frankfort was up to recent date without a public central lighting station.

In 1889 the city appointed Prof. Galileo Ferraris, Dr. Kittler, Director Uppenborn, Dr. H. F. Weber and Councillor W. H. Lindley (engineer of the city) to constitute a commission to give an expert opinion on the relative advantages and disadvantages of direct and alternating current systems, the commercial value thereof, the dangers of high tension currents, etc., etc., and, in general, the practical application of electricity to the arts, all with special reference to the introduction of electric light and power on a large scale for the city of Frankfort.

This commission did not, however, arrive at results to warrant the city acting, and it was not until after the Frankfort Electrical Exposition in 1891 that a second commission was appointed, consisting of Councillor W. H. Lindley and Oscar von Miller, to work out plans for the erection of a central station of sufficient size and capacity to satisfy the wants of the city for years to come.

In two voluminous reports, this commission advised the city to adopt the high tension alternating current system; after long preliminaries, and after the usual struggle between the rival manufacturing companies, the city gave the contract for the construction of the entire plant to the well-known firm of Brown, Boveri & Company, of Baden, Switzerland, whose senior member and general constructing engineer is Mr. C. E. L. Brown, the designer of the generators used for the Frankfort-Lauffen experiment. Under the contract this firm, besides constructing the plant, must also operate the same for a number of years, the profits to be divided by the city and firm, share and share alike. This arrangement is due to the fact that the city considers a purely business administration less expensive.

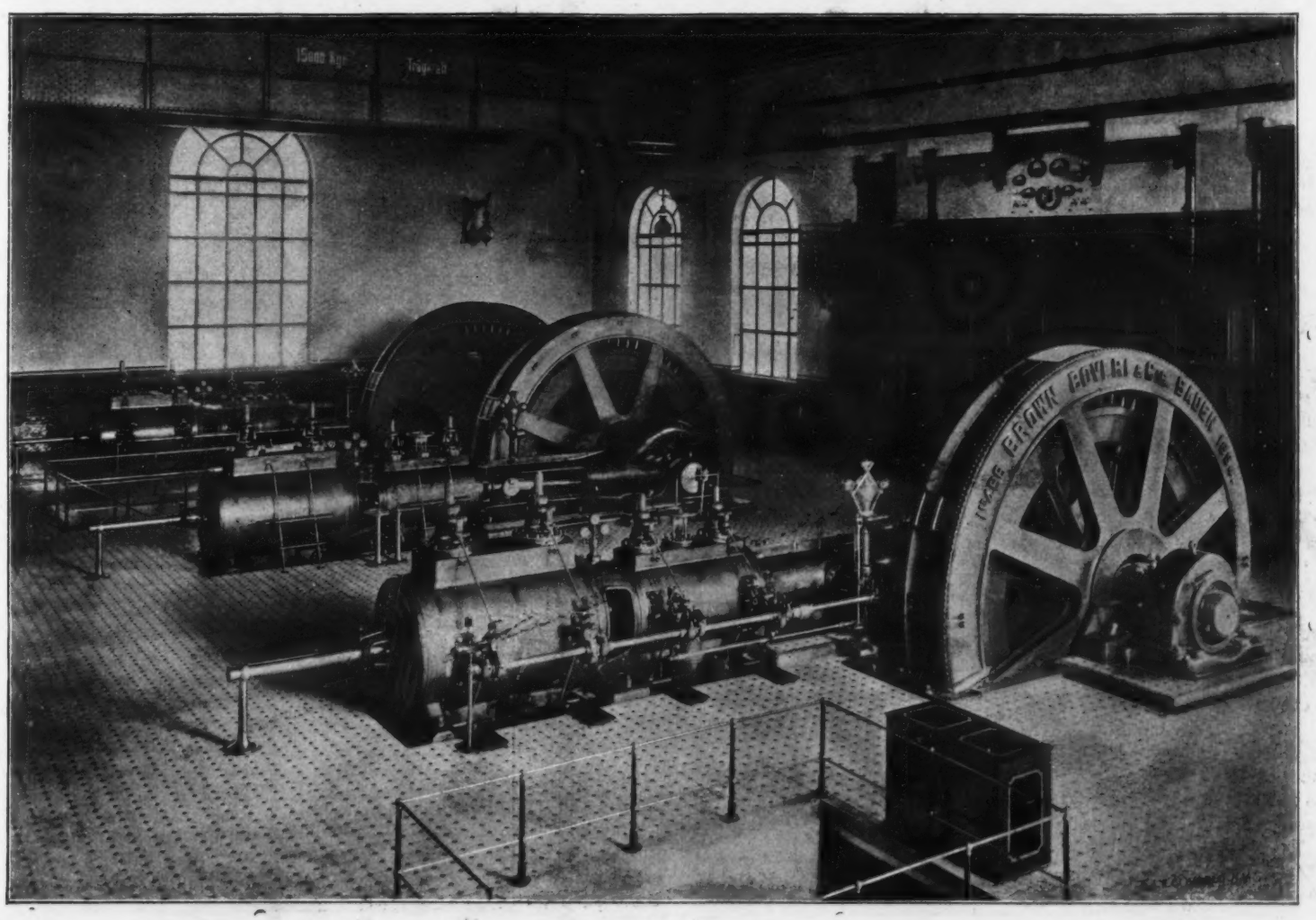
That the city decided to build a central station of the magnitude and in so thorough a manner is pre-eminently due to the unwearied efforts and efficient work of W. H. Lindley, an engineer of repute and prominence.

The station when completed will have a capacity of 10,000 hp, one-fourth of which is at present in operation. The station, the underground cable system, the transformer stations, in fact the complete installation at present in operation, will cost $535,000 including real estate.

Work was begun on the 27th of March, 1894, and on the 16th of October of the same year current was sent through the cable system, and with the exception of a few hours, regular service has been given ever since.

The Generating Station.—The power house is situated at the west end of the city, 500 feet from the river Main, from which water for condensing purposes is drawn; this position also offers an advantage, as the fuel can thereby be supplied either by water or railway. The station covers a space of 23,475 square feet; the grounds, however, are large enough to allow the present works to be quadrupled.

The building is an imposing fireproof brick structure, trimmed



GENERATOR ROOM.

with red sandstone, with a frontage of 210 feet and a depth of 210 feet. The main entrance, or front projection of the building, contains offices, testing rooms, and cable switchboard and distributing room. The main building or machinery hall is a large, well-lighted hall with iron truss roof; it is 75x125 feet, and serves as dynamo and engine room. The boiler and coal storage rooms are directly adjacent to the main building, and project in the form of two wings on either side. The condensers and all the supply and exhaust pipes are in the basement conveniently located for inspection.

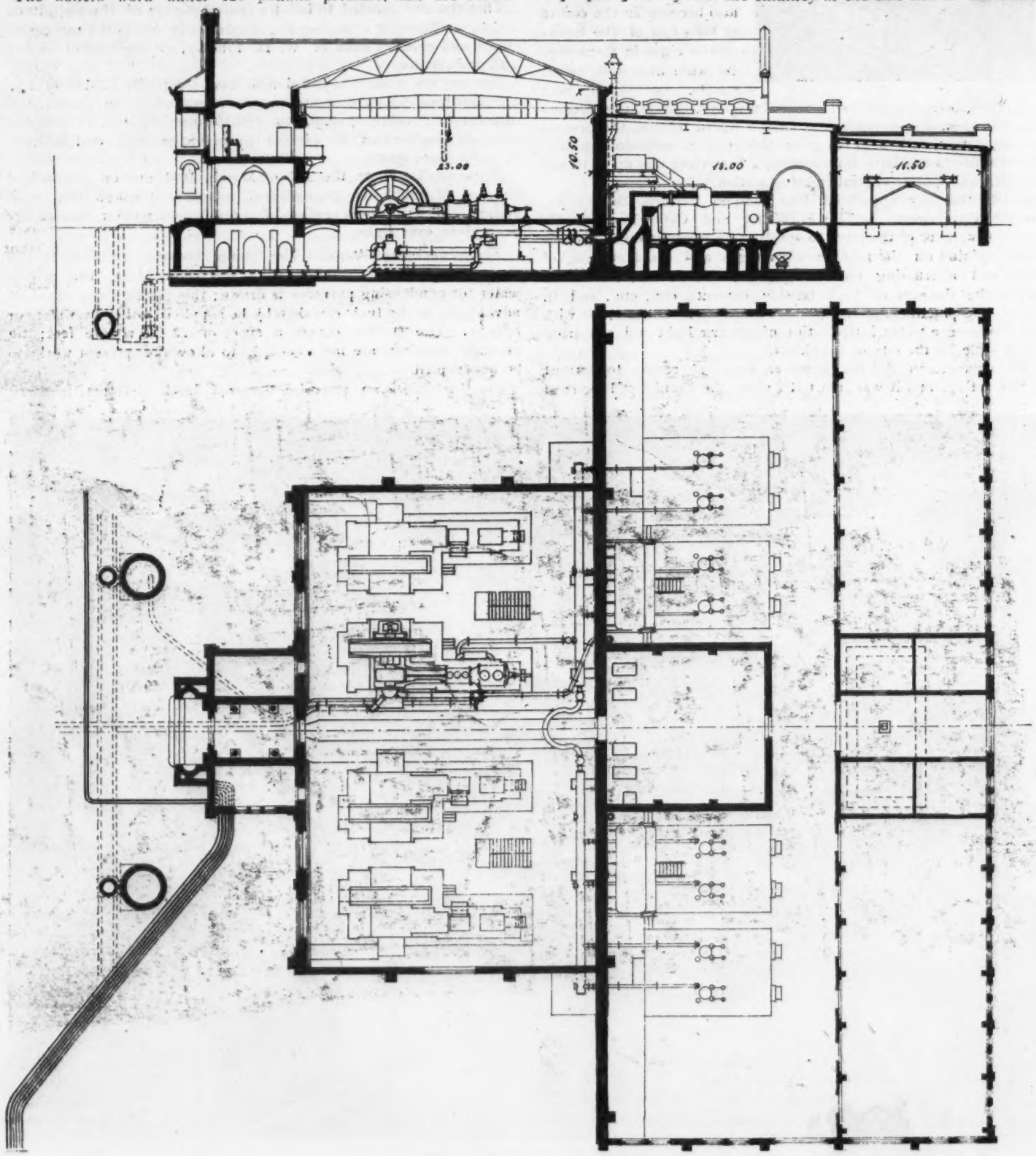
The Steam Generating Plant.—The boiler room, which is 217 feet by 59 feet, is at present equipped with eight Cornwall-Fox boilers with corrugated fire flues and cross Galloway tubes, of the following dimensions:

Heating surface	925 sq. ft.	Steam drum, length	4 feet
Length	28.8 feet	Diameter	3.28 feet
Diameter, outside	8.2 feet	Total weight	53,560 lbs.

The boilers work under 120 pounds pressure, and are walled in, in groups of two, and accessible from all sides. The furnaces are stoked by hand, and have inclined grate bars. The corrugated furnace empties into a combination chamber. The heated gases then pass underneath the boiler, turn up at the forward end, then pass along the upper outer shell into the smoke flue, directly at the rear of the boilers. The combination chamber is an excellent preventer of smoke, as it becomes hot, and the gases emptying into it ignite and thus in a great measure prevent smoke.

According to contract each boiler is to evaporate 3,300 lbs. of water per hour, under a steam pressure of 120 lbs., the feedwater temperature being 30° Celsius; under forced fires the boilers will generate up to 5.6 lbs. of dry steam per square foot of heating surface, and under all conditions not more than 1 per cent. of water may be contained in the steam.

The main smoke flue, which is subdivided into sections by means of iron doors, runs along underneath and in the rear of the boilers and empties directly into the chimney at the east end of the build-

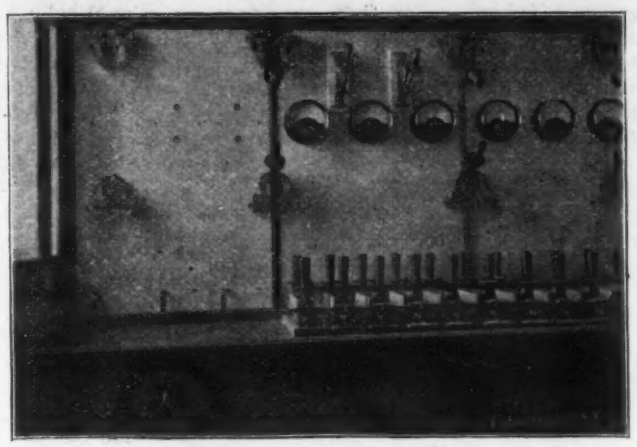


PLAN OF STATION. *Elec. World.*

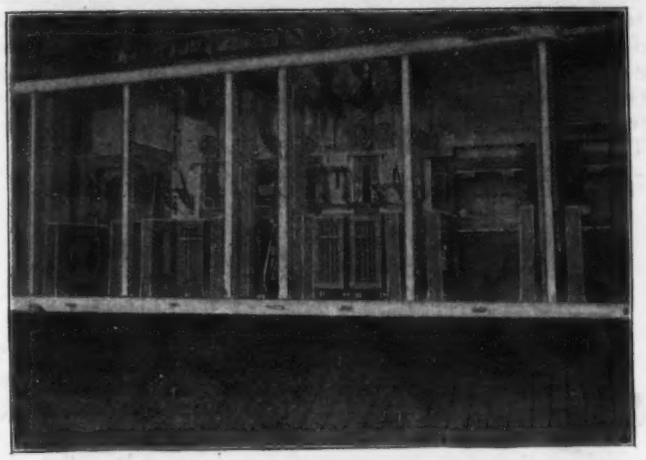
ing. This chimney has a height of 165 feet and a diameter of 10 feet.

As soon as found necessary a second chimney of the same dimensions will be built at the west end of the building. In front and below the boilers the ash pit is located, which receives the waste ashes and cinders in iron wagons.

The coal storage room has a capacity of 1,500 tons; it is traversed its entire length by an elevated track used to transport and evenly distribute the coal. An electric elevator at the west end serves as a coal hoist. Two double acting feed pumps of modern construction, each



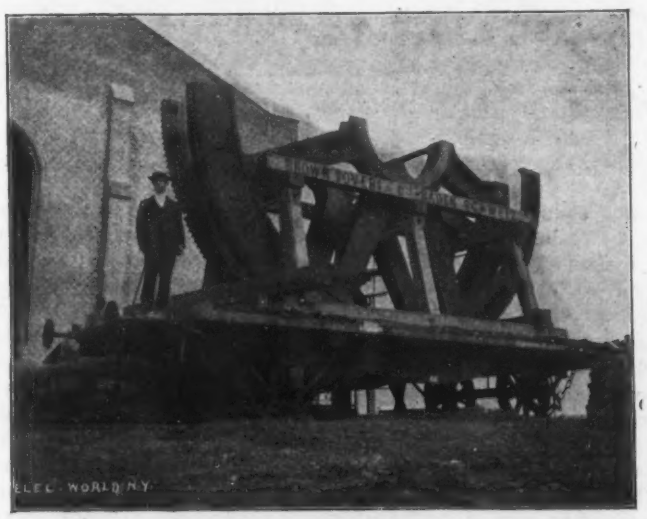
FEEDER SWITCHBOARD.



REAR VIEW OF SWITCHBOARD.

with a capacity of 5,285 gallons per hour, are located in a separate room, situated in the centre of the boiler room. A Kennedy water meter is connected to the feed pipes in such a manner that they can be cut in or out of service. Two warm water feed tanks of a capacity of 5,285 gallons are placed adjacent to the pump room, above and at the end of the boilers. The water in these tanks is heated by the exhaust steam from the pump. All feed water pipes are so arranged that any section can be cut in or out of service without interfering with the rest of the system.

Two steam receivers of 24.75 inches diameter are situated in the basement of the machinery hall between the engines and boilers



UPPER HALF OF ARMATURE FRAME.

and are joined in the middle by a copper expansion pipe. The pipes from the boilers to the receivers, and from the receivers to the engines, are patent welded tubes; all curves or elbows leading directly to the engines are made of copper.

The steam receivers as well as the various leads can be cut out of service by properly located valves. The tubes for the injection water lead directly from the suction wells, situated in the front of the building. These wells are two metres in diameter and are three metres deeper than the lowest known level of the river Main; they are connected with the river by a two-metre tunnel. The exhaust and condensation water is led from each engine directly and independently into a receiver shaft, from which it flows into the river.

Without going into further details it will suffice to say that the piping system of this station is as perfect as modern engineering can make it, no pains, experience or money having been spared to arrive at the best results.

The Engines.—Three Kuhn tandem coupled engines, each of 750 hp capacity, are at present in operation. These engines are mounted on massive foundations, and have the following general dimensions: Diameter of low pressure cylinder, 37.8 in.; diameter of high pressure cylinder, 24.4 in.; stroke, 4 feet; weight of fly wheel, 53,000 lbs.; number of revolutions per minute, 85.

The bed plate is cast in one piece, with the low and high pressure cylinders coupled in tandem. The valve gear is of the well-known Kuchenbecker type; all valve mechanism is on one side of the engine, which is also fitted out with automatic lubricating, speed indicators, etc. The steam passes from the high pressure cylinders into the receiver, placed horizontally between the two cylinders and at a lower level.

From the low pressure cylinders the steam is exhausted into the

ALTERNATING CURRENT MOTOR.

condensers connected with a vertical air pump driven off the main shaft, and the condensed steam and water of condensation are discharged by the air pump into the subway described above. The engines can be operated condensing or non-condensing, and under the contract are not to use more than 15 lbs. of dry steam per horse-power-hour, excluding the condensed water in the steam pipes, under a maximum load of 750 effective hp.

The Generators.—The alternators, which were furnished by the firm of Brown, Boveri & Company, are built directly on and about the fly-wheel of the steam engine. The field magnets rotate, while the armature is the fixed part of the machine. There are 64 poles, and, consequently, at the normal speed of 85 revolutions 2,720 complete alternations per minute.

The magnets are round, but with rectangular forged pole-pieces, and provided with cylindrical, high-edged spools, on which are mounted the exciting coils. The electromagnets are built according to one pattern, and are, consequently, interchangeable; by loosening a single screw it is possible to remove and change any magnet with its coils. The exciting current is led to the field magnets by two collecting rings, which are each provided with two sets of brushes.

The armature, which encircles the field magnets, is carried by two cast-iron wheel-shaped frames, which rest on cast, cylindrical bearings in pillow-blocks concentric with the shaft. The armature is made in 16 similar segments, which are interchangeable, and are built up of laminated iron sheets; every part of it is easily accessible for inspection. Each segment contains four coils, so that there are 64 in all, and these have a simple winding of copper strips, of only a few turns, which are completely imbedded in paper insulation.

These alternators work almost noiselessly, and with hardly any rise in temperature; they are easily and safely coupled in parallel, with no fluctuation of the voltage in the conducting system, this operation being performed without any auxiliary resistance.

The exciting machines are six-pole dynamos mounted directly on the main shaft, their armature having a series drum winding, and are so constructed that single wires can be easily changed.

Mr. Brown guaranteed the following commercial efficiencies for the alternators at different loads, including the excitation of the magnets:

Steam Engine Load.	Guaranteed Efficiency of Alternators.	Corresponding Useful Energy at the Switchboard.
a 750 eff. hp.	At least 94.5 per cent.	522 kilowatts
b 600 " "	" " 94 " "	415 "
c 350 " "	" " 92 " "	237 "
d 150 " "	" " 85 " "	94 "

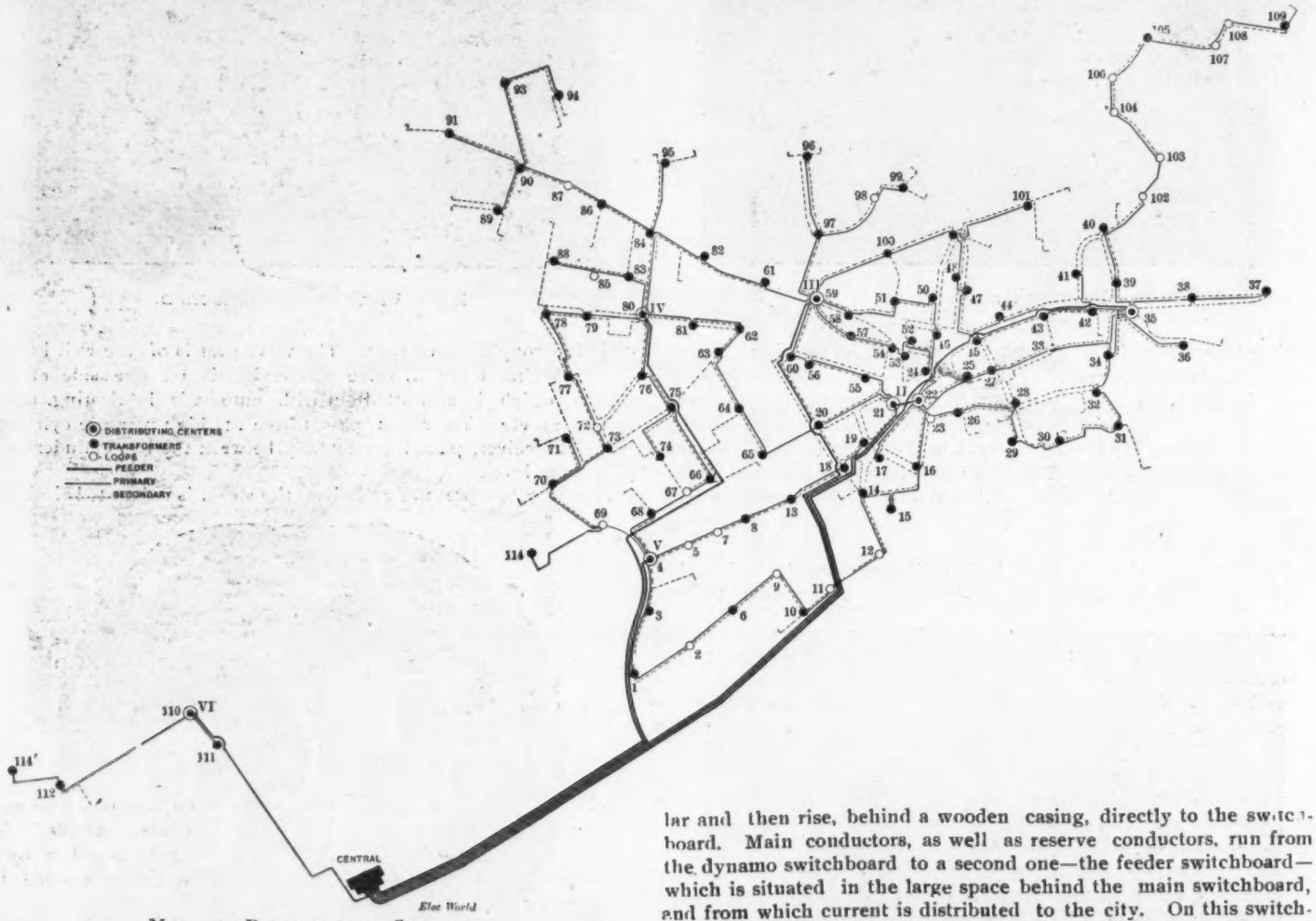
The whole plant is arranged for a maximum working potential of 3,000 volts in the primary wires.

The switchboard is mounted over the entrance of the dynamo room; in front of it runs a gallery from which the whole interior of the house can be overlooked. The wooden framework, built in most approved style, is divided into three panels, which are covered with white marble plates and have room for the connections of 12 machines.

For the present installation only the middle panel is used, and there the ammeters, voltmeters, indicators, etc., for four machines are set up. In the centre of this panel there is also a static voltmeter, with which the potential in the secondary network near the feeding points can be measured; the plugs for making connections with these pressure wires are arranged in the form of a horseshoe about the instrument. Furthermore, this middle panel also contains the large station ammeter, of a capacity of 1,500 amperes, and the station voltmeter, which gives the average potential of the system.

Each machine has its special ammeter and phase indicator, while for every two machines there is one voltmeter with a switch. No measuring instruments are provided for the exciting dynamos; the regulating resistances for these machines are placed behind the switchboard, and can be easily reached. Each dynamo can be regulated separately, or, by coupling the resistances, all at once. All the connections are conveniently accessible from the large space behind the switchboard.

The cables run from the machines on insulators through the cellar and then rise, behind a wooden casing, directly to the switchboard. Main conductors, as well as reserve conductors, run from the dynamo switchboard to a second one—the feeder switchboard—which is situated in the large space behind the main switchboard, and from which current is distributed to the city. On this switchboard are mounted the ammeters and switches for the main feeders leading to the city. The board is arranged for the complete installation proposed, consisting of 12 feeders, but at present there are in place only the ammeters for the six main feeder cables which have so far been laid, though the binding posts and levers for the safety fuses and switches of the complete cable system are already set up.



Map of Distributing System.

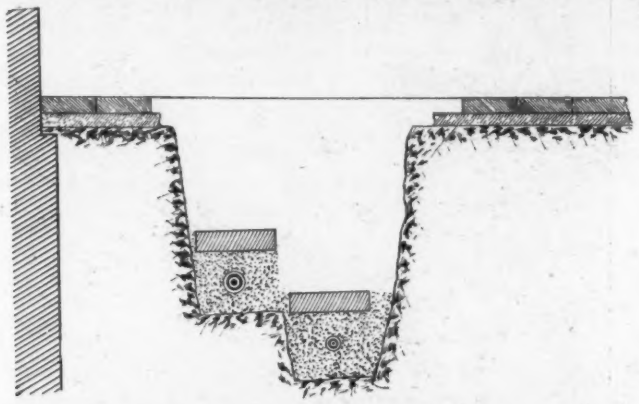
The distribution in the city is effected by means of transformers connected in parallel, and a secondary conducting network. Carefully made calculations showed that this system would entail by far the least initial cost, even though the engines and dynamos must have a greater capacity than those in a central station with accumulators; similarly, calculations gave an earning capacity of 11¼ to 12 per cent. for the whole plant, the highest return on the capital invested compared with other systems.

The primary potential of 3,000 volts was chosen in the belief that in the present state of engineering it is entirely possible to keep underground cables with this potential in steady operation, and, moreover, with the safety which is essential for such a system, and that with this tension the losses in the main conductors could be extraordinarily diminished without employing too great sections of copper. At full load, the losses in the feeders amount to 4 per cent., in the primary distributing network 1 per cent., and in the secondary network 1.5 per cent.

A secondary distributing network was decided on, because the

size of the transformers could thus be better suited to the consumption of current, as in this case a transformer must supply a considerable number of consumers. As, furthermore, the transformers can be decidedly larger, another advantage of this arrangement is a surer and more economical operation than with small individual transformers for every user, which latter plan would also have the disadvantage of carrying the high-tension currents directly into private dwellings. Moreover, with large transformers feeding a secondary network, individual consumers are more independent of disturbances in the transformers, as in such cases all points of consumption are easily kept in operation.

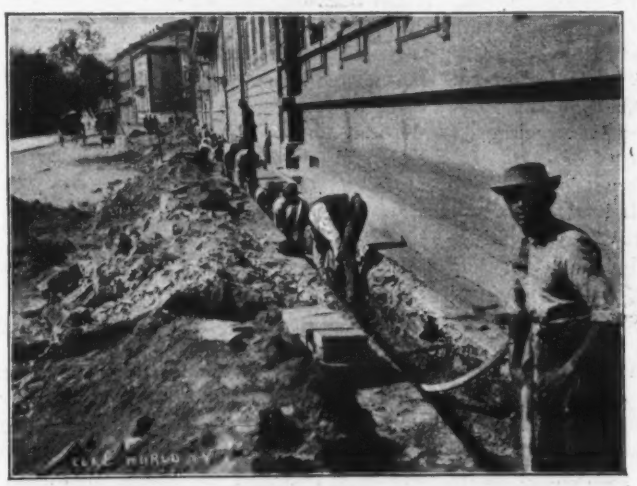
It has, indeed, been asserted that when a transformer becomes overloaded and has its safety fuse blown, the neighboring transformers will likewise become overloaded and blow their fuses, so that by this means a large part of the network will cut itself out. But this overloading can go on only until the limiting capacity of the safety fuse of the secondary cable running to the lamps belonging to the troublesome transformer has been reached; then the cable fuse will blow, the comparatively small overloaded region will be cut out, and the remaining part of the network remains intact. As a matter of fact, a case which confirms this latter view has



CONDUCTORS INSTALLED IN TRENCH.

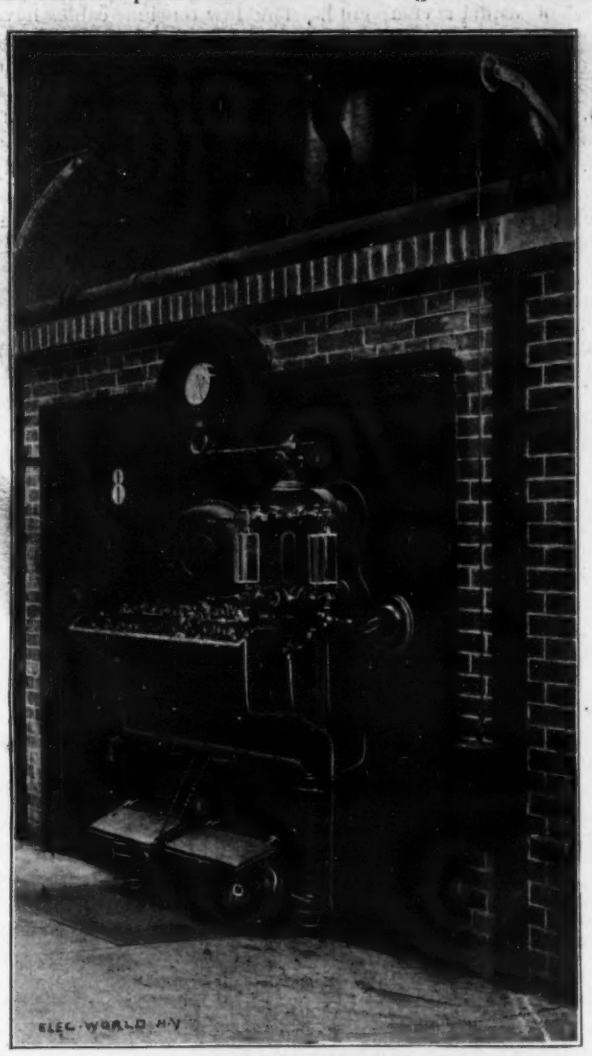
occurred, in which the overloading of the transformer was brought about by the fact that light was furnished free of cost, and shortly before Christmas the owners of shops not only burned all their lamps simultaneously, but even had a large number installed temporarily.

From the central station there run six main feeders (as already mentioned) to as many feeding points in the city, which, as far as possible, are fixed at centres of consumption. These points, in the cable diagram, are designated by double rings, and numbered from I. to VI. At No. II it was necessary, on account of the great number of connecting cables, to duplicate the feeding point, as can be seen on the diagram, in such a manner that a primary conductor of 590,000 cir. mils (210 mm²) section had to be drawn to the opposite side of the street. From these main feeding points the high



LAYING CABLES.

tension network branches to the transformer stations, which are designated by simple points. This network is so arranged that every two feeding points are joined together by high tension conductors, to which the transformers are connected in parallel. The individual parts of the high tension conductors have no further connection among themselves, an arrangement which makes it possible to quickly find any fault occurring in the network. Another advantage of the conductors running from feeding point to feeding point is that every transformer can obtain primary current from two sides, and if disturbances should occur at any place in the high tension network, the transformers will still be kept in full operation and only the defective piece need be cut out. A great source of safety



FRONT OF ONE BOILER

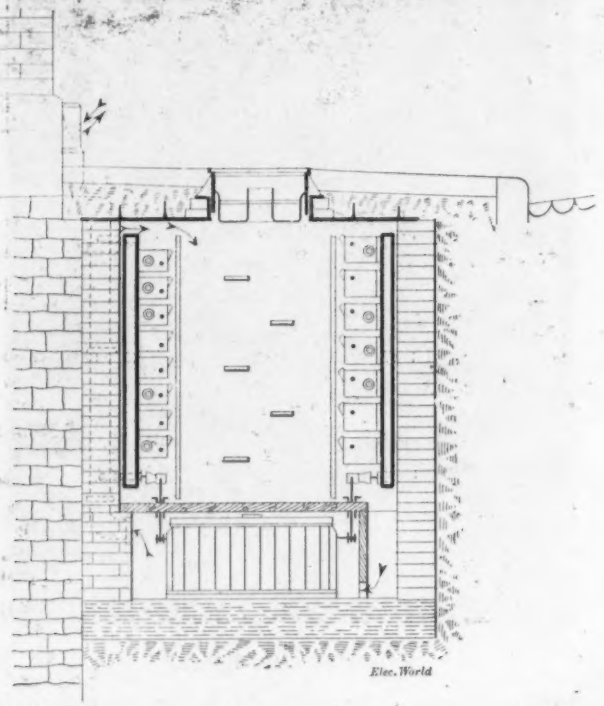
against the occurrence of faults lies also in the fact that connection boxes in the primary network are almost entirely avoided. The different transformers are furthermore connected together by the secondary network, from which the current at 120 volts is led into the houses.

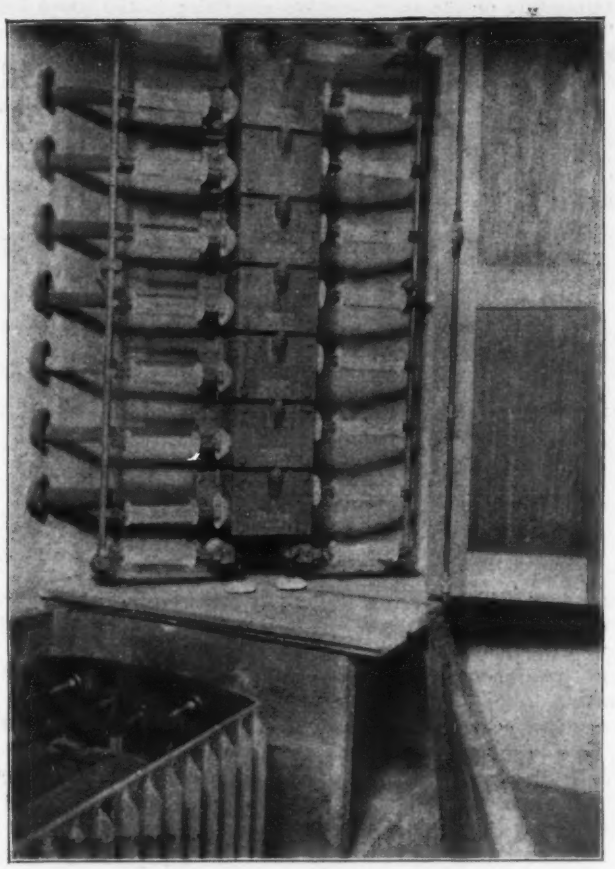
The cables are laid throughout under the sidewalks in order to keep the roadway open for traffic while excavating. At street crossings the cables are drawn through iron pipes. They are besides imbedded in clean sand, and in order to preserve them from injury while the ground is being dug up, they are covered, the main feeders with wrought iron plates specially treated to preserve them from rust, and the cables of the secondary and primary conducting network with bricks. High and low tension cables lie in the same trench, which has two steps, as shown above. The secondary cable lies in the upper step, two feet (60 cm) below the level of the sidewalk surface, the primary cable four inches (10 cm) deeper, and to one side. The distance of the secondary cable from the foundation walls of the houses is also two feet (60 cm); so that the branch cables to the houses are very short, while there is yet sufficient room to set the branch connection boxes comfortably. The cables connecting with the houses terminate in a box, in which at the end of the cable is imbedded in an asphalt insulation, and in whose upper part are the house safety fuses. The box is also a switch, for when it is opened the house wiring is cut off from the street network.

All the cables were furnished by Felten & Guilleaume, of Mulheim, on the Rhine, and were entirely laid within four and a half months. The total length of the conductors amounts to 46½ miles (75 klm) of concentric cable, and four miles (6.5 klm) of many stranded pressure cables. For the high tension of 3,000 volts, con-

centric lead cables with iron ribbon armor and with sections of from 50,000 to 420,000 cir. mils (25 to 210 mm²) are used; these reach a total length of 24 miles (37 klm). The thickness of the insulating layer between the inner and outer conductors is 3 16 inch (5 mm); the outer conductor is surrounded with an equally thick layer of insulation and the whole is covered with a double wrapping of lead and double iron ribbon armor, which is provided with a coating of asphalt compound. The low tension cables have the same construction, with the difference that the insulating layers have a thickness of only ⅛ inch (3½ to four mm). The sections of the low tension cables are 140,000 and 200,000 cir. mils (70 to 100 mm²), but for some individual consumers who are directly connected to transformer stations, the sections run up to 670,000 cir. mils (340 mm²). The length of the secondary network which is already laid amounts to 23½ miles (38 klm). The insulation resistance of the whole cable network, including all connecting parts, amounted, on the day of its acceptance, to more than 6.2 megohms per mile, at 32° F.

The transformer stations, contrary to the usual practice, are placed in specially arranged pits situated below the level of the streets. These pits are 9 feet (2.85 m) deep, 6 feet (1.8 m) long and 4 feet 8 inches (1.4 m) wide. They are covered with an iron plate, and have a manhole closed water tight. The transformers





TRANSFORMER PIT.

are placed in the lower part of the pit, and are covered by a wooden floor.

The cables in the pits are arranged systematically, the secondary cable being always led into the bus bar on the house side, the primary cable to that on the street side. Furthermore, the outer and inner conductors in all the shafts are separated by having the safety fuses of the two on opposite sides, so that those of the inner conductor are always on the right, when one stands in the pit with his back to the secondary cables. This is done principally on account of the primary cable, in order to avoid mistakes in connecting it, which would cause a very high tension in the inner conductor, amounting perhaps to many times the normal operating potential.

The equipment of the pits can be seen from the illustrations. The cables run to a terminal box screwed fast to iron bars, from which the two poles are led out to the sides. On both sides are mounted round copper rods of 1 1-5 inches (30 mm) diameter, fastened to the insulators, which serve as bus bars, and to which the cable is attached with safety fuses which also act as cut-outs. The lead strips of the primary safety fuses are placed in porcelain troughs, which are filled with dry sand, etc., so that when the fuses are burned the molten lead will be prevented from flying about. The secondary fuses are mounted on ordinary porcelain plates.

Placing the transformers underground was the subject of considerable study; it was necessary particularly to consider whether the heating in the pits would not be so great as to endanger the insulation of the high tension cable, and whether it would be possible to keep the pits dry during sudden variations of weather. These questions were happily solved by the setting up of a ventilation which was kept going by the heat generated by the transformer. In order to provide a path for the circulation, an iron box was placed at the top of the pit, and divided into two air tight parts, which contain, respectively, the entrance and the exit of the circulating air. The wooden floor over the transformer does not quite touch the wall on one side, and here a tongue-shaped piece sticks down as far as 4 inches from the bottom of the pit. On the opposite side there is an earthen pipe, built into the wall, which has an opening close under the floor, and leads to one division of the cast-iron ventilation box. The cold air now enters through the corresponding division of the ventilation box into the pit and circulates behind the wooden floor under the tongue shaped piece, over the transformers and to the ventilating pipe and out through the other division of the box. It has been determined by measurements that the temperature in a pit, with the transformer at full load, does not rise over 38° F, with an outside temperature of 41° F.

The Frankfort central station begins operations on a much larger scale than is recorded of the stations of other cities. The part finished is announced to be able to take care of 35,000 incandescent lamps, or their equivalent, and there are now about 20,000 incandescent lamps, 50 arc lamps and 13 motors connected. The motors will in a few days be increased to 30, and altogether application for 31, aggregating 180 hp, has been made. They will be distributed among the following various occupations and places: printing establishments, bakery, ice manufactory, furniture factory, accumulator factory, copper smithy, machine shop, drug factory, mill building establishment, tannery and butcher shop.

The time of operation has been too short to render a final decision on the results which are expected, but in the meantime it is certain that the plant in all its parts answers every requirement with small cost of operation, and the choice of the system will, it is believed, be justified by the outcome.

The Way They Do Things in Switzerland.

According to the London *Electrical Engineer* the Swiss Council have agreed to grant the franchise for the electric railway running to the top of the Jungfrau, "on condition that the company contributes $20,000 to the construction of the observatory as well as monthly subscriptions to certain scientific societies."

Convention of the Northwestern Electrical Association.

The third annual convention of the Northwestern Electrical Association was held at Milwaukee on Wednesday and Thursday, January 16 and 17, and the success of the last meeting was repeated both in the attendance and interest manifested in the proceedings. As at previous meetings, the discussions were well sustained and lively in their character. The more purely commercial feature of the convention was rendered prominent by a large contingent of representatives of supply and manufacturing houses, some of whom made considerable displays of wares in the parlors of headquarters.

The meeting was called to order by President C. C. Paige, of Oshkosh, at 11.20 A. M. of Wednesday morning. Mr. Paige, in his presidental address, dwelt upon the magnitude and importance of the electrical industries in the United States, stating that there are now over two hundred millions of dollars invested in electric light and power plants. He referred to the advocates of municipal ownership as engaged in "an unholy, infamous, communistic warfare on these and kindred enterprises," which is not only antagonistic to the true principles of our institutions but to government itself and to fair-minded business equity. He predicted that if such principles should get a foothold in this country they would gain control of legislation and management of public affairs to such an extent as to embarrass if not wholly destroy these great interests, and he called upon investors for a united and vigorously pursued effort to head off the advocacy in this country of what is denominated as communistic European ideas of government. Reference was made to the advocacy of municipal ownership by some manufacturers of electrical apparatus, who having induced private capital to invest next turn their energies to excite and encourage competition, either through municipal or so-called citizens' plants. The president expressed his pleasure at seeing such a large number present at the meeting and felt assured in saying that the association now has a strength that can be useful and be beneficial to all. Mr. F. Copeland, of Lacrosse, complimented the president, saying that in it there is a great deal of food for reflection, the remarks being to the point and should be well considered by the members. The meeting then adjourned until 2 P. M.

The afternoon session was opened by Mr. Pliny Norcross, who read a paper on "Hints upon Daily Work About a Dynamo Plant."

Mr. Norcross said that the creation of electricity by a dynamo was just as great a mystery to him now as it was in 1885 when his plant was first started; he had made some desultory efforts to learn something about electricity by reading books, but they contain so many strange words and symbols that he got tired and sleepy, and had long ago given up trying to learn anything about the subject. Of late when he desires any information he hires some one to tell him, but also relies a great deal on men who travel for electrical companies and supply houses for his information.

Mr. Norcross referred to the desirability of a dry and solid foundation for dynamos and the necessity of care in finishing generators so that the armatures are accurately balanced in order to avoid vibration, and good workmanship throughout is declared to be as essential as the electrical features. He favors slow-speed dynamos with heavy, substantial and broad bases, large accurately turned shafts with heavy boxes babbited with the very best material, and wide pulleys; he believes in the use of wider belts than is really thought necessary and the use of the best lubricant that money can buy. He states that the blower is a great help and that a current of cool air directed upon the heated parts may prevent disaster. Slipping of belts is referred to, which is stated to be sometimes due to the belting being too short, other times too narrow, or to overload; or the pulley of the dynamo may be so small that the belt cannot get sufficient contact with its surface; excess of speed, and greasy belts are also causes of slippage. He advocates the use of wider belts as a means of relief, the belt being kept pliable by the sparing use of some good belt dressing; iron wheels are preferred for large driving pulleys and wood or fibre for small driving pulleys; iron pulleys may be improved by putting leather, canvas or paper on the outside, but this must be carefully done by an expert or it will come off and make serious trouble. Mr. Norcross considers the day of high-speed dynamos past and advocates uniformity in the dynamos and lamps in a plant.

In placing wall controllers he suggests that it is well to do it in such a manner that they cannot tremble; in case of a wooden frame building he advises a post through the floor and sunk well into the ground so as not to be affected by vibration, the wall controller to be secured to a plank crossing the upper end of the post. He likes a plain carbon better than one coated, and with a rounded or blunt or even flat end, that the carbons may be less likely to slip by each other between the time of trimming and lighting. By the use of one-half inch carbons he now obtains 10 or 11 hours of light.

Mr. Norcross advised that fibre or hard rubber instead of lignum vitæ bushings be used as the latter material is checked by heat.

In wiring through trees, he recommends that a couple of pieces of thick narrow board be used 18 inches to two feet long grooved so as to receive the wire and then wired together under the offending limb. Mr. Norcross thinks the electric light is more expensive than gas, and states that the most disastrous course ever pursued by the men who put in an electric light plant in competition with gas, is to announce to the public that the new light is cheaper than gas. The electric light stands firmly enough upon the fact that it is a better light than oil or gas. Mr. C. C. Burton next read a paper on "Interior Conduit and Interior Wiring." It is generally considered, he said, that the majority of interior wiring found in most cities is such as reflects little credit on its author and less on the companies who allow it to menace property running current through it. It is far better, he thinks, to have high grade exposed wire than to use low grade concealed wires, and that the ideal method of wiring as far as concerns security and insulation is exposed, heavily insulated wire supported upon non-combustible insulators. Without using interior conduit he considers that concealed wiring cannot be of such a character as to secure the necessary immunity of life and protection from fire hazard, or enable inspection at all times subsequent to installation.

Mr. Burton describes the interior conduit system of installation at length, including the latest form, the iron conduit. As to the cost of installing interior conduit he states that in actual practice it has been shown that it will require an additional expenditure of only 20 per cent. for plain conduit and 40 per cent. for brass conduit, these figures being based on the cost of installing interior conductors by the old method, while the cost will not average more than 10 per cent. for plain and 20 for brass conduit over the system now required by insurance regulations. The recent concession of the underwriters permitting two conductors to be used in a single tube of iron armored conduit is referred to as likely to open a wide field of use for this form. Practical experience has demonstrated that a building can be provided with iron armored conduit and conductors placed therein at an expense less than with brass armored conduit using the double tube system.

In the discussion which followed, the fact was brought out that while in many instances the insurance rate has been raised on account of wiring, the wiring itself was not so much at fault as was the system of conducting it in the buildings, and that the fuse blocks were the most frequently to blame for accidents. It was suggested that some system of examination be established that would prevent incompetent men from wiring buildings; by thus bringing up the standard of safety the rates of insurance would again be lowered to normal figures. It seemed to be the sense of the convention that insurance men, if no other cause of fire could be assigned, attributed it to electricity. Mr. Sullivan made favorable mention of the good accomplished by the Chicago board of inspection and suggested that their methods be estabished generally where possible. The meeting adjourned until eight in the evening.

At the evening session Mr. William Goetz read a paper on "Incandescent Lamps vs. the Welsbach Burner." In the discussion Mr. Farwell, who operates both the electric and gas plants at Waukesha, having practically no competition, took the side of the Welsbach burner, claiming that it was a better and cheaper light than the incandescent lamp. The Welsbach burners were introduced by Mr. Farwell to protect himself on account of the considerable objection made when the price of incandescent lighting was raised by him from ½ to 1 cent per lamp hour. The discussion which followed the remarks of Mr. Farwell seemed to show that on account of his not having the latest machinery the electric light furnished by him was defective; and, therefore, there was naturally greater satisfaction given by the Welsbach burner. It was stated that many people objected to the Welsbach burner on account of the ghastly hue imparted to surrounding objects. To meet the competition of the new burner it was suggested that lamps be replaced before burning out, thereby keeping up the efficiency of the light. Mr. Thorp did not think much trouble was to be anticipated from the new Welsbach burner, and said that after electricity had been in the field as long as gas, there would no longer be any comparison between the two. The general feeling was that while electricity was not as

cheap as gas, it was preferable to any style of gas burner on account of its better and more agreeable light, greater cleanliness and healthfulness.

Mr. John R. Markle then read a paper on "Some Characteristics and Economies of Accumulators as Applied to Central Lighting and Power Stations." Mr. Markle said that storage batteries could perform the important functions of storage of equalization of pressure, and of transformation of E. M. F. and current more perfectly and at the same time with greater economy than any other apparatus. They enable reductions to be made in the cost of feeders to distributing points on account of possessing a better time factor and, on account of the influence on the load factor, also involve less first cost of generating machinery and greater economy of operation. He stated that the space required for the accommodation of storage batteries is less than for steam, air or water storage, until very high pressures are reached; a space of 10 yards square will accommodate a battery having a capacity of 1,000 kw hours. He referred to the perfect manner in which pressures may be equalized or controlled by means of storage batteries and the manner in which short circuits and grounds may be promptly blown by them. As a consequence of their regulating properties higher efficiency lamps may be used; a saving in this respect over the employment of what he denominates "dead or live" equalizers being about 20 per cent. and over alternating transformers of from 25 to 45 per cent. Mr. Markle referred to a recent visit to Portland, Ore., where alternating currents will be transformed into continuous currents for lighting and for stationary and street railway motors, and as the voltage employed is but 6,000 and the distance only 14 miles, he asked why continuous currents instead of alternating were not employed in the first place. The first cost of producing and installing storage batteries, he states, is generally misjudged for the reason that there is a lack of knowledge of the many details of manufacture of properly constructed elements and of the necessary auxiliary apparatus for the working, labor, freight, and supervision, are not taken into consideration, nor the interest on the capital invested in factories and machinery and on the necessary capital, the cost of selling—such as solicitors' and agents' salaries—nor the loss from bad debts, cost of insurance and taxes, cost of administration; besides the above are the expenditures for books, stationery, advertising, etc.

He stated that the railway power house offers the most favorable opportunity for storage batteries on account of the frequent and wide variations of load. In a case quoted where storage batteries were thus applied the results showed a saving of 2.2 pounds of coal per hp hour, involving a saving of $2,500 per year; the cost of storage batteries would be recouped in this case by the saving of coal alone in four years. This saving would be due to the fact that the engines are running continuously at their best efficiency with less repairs, and also owing to the absence of load variation, burning out of generators and motors, etc.

The following comparison of the cost of direct and storage battery systems is given.

500 hp direct system.

Cost of steam plant at $70 per hp	$35,000	
Cost of 400 kw electric plant at $30 per kw hour	12 000	
		$47,000

500 hp storage battery system.

250 hp steam plant at $70 per hp	$17 500	
200 kw electric plant at $30 per kw	6 000	
Accumulator of 750 kw hours capacity at $30	22,000	
		$46,000

On Thursday morning Mr. G. L. Cole read a paper on a comparison between charging for incandescent lighting by meter and by contract systems, in which he gave his experience in changing to the meter plan two years ago in Beloit, Wis. At that time some customers were charged by contract and others meter rates, and the two questions that came up for consideration were in regard to the outlay on the meters, and whether the additional returns would warrant the change.

To compensate for the extra investments in the meters it was decided to charge a meter rental which now pays a good percentage. Mr. Cole found that on the contract plan with 825 incandescent lights wired, the daily average load was 450, while with the meter system, he could now calculate on only one third of the installed being in use at one time. As an instance of the difference between the two systems, one customer formerly paid $3.50 per month, while at meter rates he paid $7.64 per month. By the meter plan a minimum charge of $1 per month is made when a house is not occupied, while if this serivce was furnished on contract there would be much difficulty in collecting on account of the customer desiring a discount because lights were not used. Another advantage of the meter system was that smaller transformers can be used, as a customer would not use at any time all the lamps wired unless on some special occasion, when a large transformer could be temporarily installed. In illustration a case is given of a factory in which 95 lamps were installed and where a 50-light transformer is used and whose bills at the rate of 20 cents per kw average $57.13 per month. In another factory where 180 lights are used only until 6 P. M., a 150-light transformer is installed, and an additional 40 lights connected for lighting a lodge room later in the evening.

Mr Cole has now 3,300 lights wired from two dynamos, one of 750 and the other of 1,000 lights, and the average increase is about 115 lamps installed per month. He finds that people will put in more lights when they use the meter system than under contract system, and this adds to the profit from wiring. The conclusions are that with the meter system the station receives pay for the current furnished, and the customer pay for the current received. The service is more satisfactory, and the meter admits of a larger field to be covered than is possible under the contract system. Economy is stimulated on the part of the customer, and tends to make the owner also pay more attention to this point. The meter system is eminently fair to both parties, and soon after its installation commends itself to the public.

Mr. G. Herbert Condict read a paper describing the use of the storage battery in connection with the lighting and street railway plant at Merrill, Wis., which we reprint in full elsewhere.

Mr. Charles E. Gregory delivered a short address on the subject of electrical business, the keynote of which was the principle of paving the way for a profitable business by obtaining the confidence of customers through fair dealing. He laid stress upon the desirability of looking out for economies in central station practice and particularly with respect to the steam plant. When in the dark in regard to any point, he advises the employment of an expert and as an instance says that in the case of scale in the boiler, it would be advisable to have a chemical analysis made of the water, and a prescription obtained based on this.

The reports of committees were then received, and officers were elected as follows: President, H. C. Thom, Madison; First Vice President, Geo. G. Grim, Jefferson; second Vice President F. Copeland, LaCrosse; Secretary, William Goltz, of Milwaukee; J. Schuete, Manitowac.

Mr. Thom being called upon to make an address, said he felt keenly the generous endorsement which his election to the presidency implied, and hoped that his conduct in the administration of his duties in behalf of the organization would be of such a character as to merit the mark of appreciation bestowed. He said he was greatly interested in the progress and good results that could be brought about by the Northwestern Electrical Association, which was now getting down to businesss, and he believed that its influence would continue to grow until it would be looked upon as a potent factor in shaping the policy of the interests which it represents.

The following board of directors was elected: Chairman, F. Copeland, Lacrosse; O. M. Rau, Milwaukee, and Mr. Highland of Clinton, Ia. It was decided to hold the next meeting in Chicago.

A suggestion was made that the name of the association be changed so as to include the entire Western States. This was opposed on the ground that the association was formed to be a benefit primarily to its members, which would not be the case if they were composed of representatives from different sections of the country where interests and conditions widely varied.

WORTHY OF SPECIAL MENTION.

Washburn & Moen Mfg. Company had a good supply of envelopes, filled with samples of insulated wire, price lists and copies of its "Pocket Handbook of Iron and Copper Wire in Electrical Transmission." Messrs. Whyte and Gage were kept busy supplying these.

The General Electric Company took special pains to illustrate its claims to the patronage of central station managers. It displayed a fine lot of specialties in the club room, and had two arc lamps burning on the hotel circuit to demonstrate the advantages of its constant current arc lamps. When Mr. A. C. Bunce wasn't busy with his work for the convention, and that seemed to have no end, he was hard at work in the interest of his firm. He was ably assisted by Mr. W. J. Ferris.

The New Helios Arc Lamp enjoyed the distinction of being better displayed than was ever an arc lamp in the history of conventions. By the aid of lenses, the crater of the arc in two lamps was perfectly reproduced on a sheet of muslin. This showed the manner of burning as nothing else could do. Mr. Chas. G. Burton, of the Central Electric Company, is to be credited with

arranging the display, and with making many friends for the Helios.

Geo. Cutter, accompanied by Mrs. Cutter, was one of the most notable characters present. He looks as well as of old, and seems to find business all right.

The Metropolitan Electric Company had, as usual, an exceedingly good representative in Mr. L. W. Burch. He made his exhibit attractive, and was continuously on the move.

The Peoria Automatic Filter was cleverly displayed, both in exhibit and literature. It had a parlor all to itself, and no end of attention. Mr. J. A. White looked after the display.

Kerite Wire carried away the honors of the wire displays. Its destiny was in the hands of S. F. B. Morse, and that gentleman did the thing right. He provided a novel entertainment in the performance of Prof. Patterson, who gave a splendid act of swinging electrically lighted Indian clubs. The "Kerite" parlor was a popular resort.

The Central Electric Company had the best exhibit of any supply house. It was handsomely arranged, and the accompanying literature was exceedingly effective. Mr. H. D. Latimer worked hard all the time to maintain the position of the celebrated house, and he succeeded. This gentleman has earned his right to particular mention, because of his excellent work on the Central supplemental catalogue, of which mention has already been made in these columns.

The Chicago General Fixture Company made a handsome display of its leading specialties that called forth many favorable comments.

"Billy" Low easily made himself the leading spirit of all the fun. His company was much in evidence in line of displays. Mr. Low and his able assistant Wilson, industriously circulated a neat leather case filled with samples of fuse wire. These made a decided hit.

Chas. E. Gregory, one of the most popular fellows in the business, gave the delegates something of a novelty in the way of literature. He distributed a card with portraits of four of his "positive" stockholders. Gregory's paper was also well received.

R. H. Pierce was accompanied by Mrs. Pierce. "Dick" was the chief authority on knotty problems, and he was frequently called on at the meetings.

John R. Markle, who, by the way, THE ELECTRICAL WORLD wishes to congratulate on his recent entry into the great order of the "United," was accompanied by his charming bride. His paper and advocacy of storage battery made him a prominent figure at all times.

M. M. Wood, whose railway specialties are known the world over, and who is now in business for himself, at 1536 Monadnock Block, Chicago, distributed cards bearing his familiar face, and data concerning his devices.

The Western Electric Company, having recently entered the supply field in earnest, sent Messrs. Ellicott and Wilkinson to represent them.

The Dearborn Drug and Chemical Company distributed a particularly interesting leaflet, bearing the significant proverb, "An ounce of prevention is worth a pound of cure." It also gave away a tortoise shell calendar for 1895.

Storage Batteries for telephone work were described in the leaflet of the Pumpelly-Sorley Storage Battery Company.

M. B. Austin, recently appointed Western agent for the Safety Insulated Wire and Cable Company, made a splendid impression on the delegates, and moved the letters K. K. up several stages on the scroll.

Sunbeam Lamps sparkled wherever Mr. F. S. Terry went. In the illuminated clubs of Prof. Patterson two "vapor" lamps, the manufacture of which type was interrupted by patent litigation, blazed in all the glory of a superior illuminant. It is understood these will soon be placed on the market.

J. M. Hill kept people reminded that "Columbia" lamps were strictly in it, and he succeeded, apparently.

Henry S. Hive and Max A. Berg carried the Wallace Electric Company's colors.

Buckeye Lamps had a strong and eloquent adovcate in Mr. J. H. Cooke, who seemed to be exceedingly well liked.

James Wolff did the honors for the New York Insulated Wire Company, and he was eminently successful in keeping himself and Grimshaw wire under the most favorable light.

Mr. F. S. Terry, one of the original founders of electrical associations, and one of the best known men in the business, distributed cards showing that he has taken up a few leading specialties as manufacturers' agent. The C-S automatic magnetic cut-out is one of these. Mr. Terry's host of friends will be delighted to learn that he is again in the saddle in earnest.

T. R. Mercier, of the Milwaukee Fire Alarm Company, was one of the ruling spirits of the convention.

Globe Carbons were represented by Mr. Chas. L. Rodman.

Mr. J. R. Allen consulting engineer of 1627 Monadnock Block, Chicago, was one of the newcomers who made many friends.

Mr. Jno. C. McMynn, introduced to the electrical world through his connection with the lighting of the famous Ferris wheel, had the honor of being the only man to become both an active and honorary member. "Mac" is one of the best of fellows.

C. B. Fairchild, editor of "The Street Railway Journal," and several publications connected with that enterprise, was an interested listener to all the proceedings.

The C. M. & St. P. R.R. placed a special parlor car at the service of the Chicago contingent. The trip to Milwaukee was exceedingly pleasant.

Some one told a story about Sunbeam lamps. A gentleman and his wife went to visit Mr. F. S. Terry in Chicago, and in the distance they saw a light which the gentleman insisted was a locomotive headlight. It proved to be an ordinary "Sunbeam," and as he represented another lamp, his wife had the laugh on him.

The proceedings were made unusually interesting by the brisk debates. Many of the members are lawyers, and for downright cleverness, take a Wisconsin lawyer, and bet on him to win.

The banquet will never be forgotten. To learn all about it our readers will have to ask some of those who were in attendance. "It was a good thing; push it along," and about expresses it when we look forward to future meetings.

The Electrical Engineers, of St. Paul, gave away a neat and serviceable diary pocket book for 1895 that was highly appreciated.

A Storage Battery Electric Railway and Lighting Plant.*

BY G. HERBERT CONDICT.

The city of Merrill, with a population of about 9,000, is situated on the Wisconsin River in the lumber regions of Northern Central Wisconsin, 255 miles north of Milwaukee. The city is divided by the Prairie River (which here flows into the Wisconsin) into two parts, the east and west side. The Merrill Railway & Lighting Company operates the trolley road running between the two extremes of the city, a distance of 1¼ miles. The road was built for three cars with two turnouts, but only two cars are run ordinarily. The cars are run without a schedule, making the round trip in from 20 to 30 minutes, according to demands of travel.

Power is supplied from a water wheel at the east side plant of the company, situated near the track, about one-half mile from east end. The water wheel is run without a governor, as that was found to be useless, owing to sudden variations of load. As can be readily understood, the running of cars under these conditions was not at all satisfactory.

The electric lighting of the city is divided between two stations, the east side one being run from the water power plant before mentioned, situated at the centre of the east side light distribution, and the west side from a steam plant. The east side equipment consists of two 25-kw Edison dynamos, carrying a maximum of 1,000 lights on the 3-wire system; and a United States 500-volt machine for municipal lighting, carrying 150 lights, 5 lamps in series. The west side equipment comprises a 20-kw Edison machine, carrying a maximum of about 400 lights on the two-wire system, and a Weston 150-light, 500-volt machine, and a 30-light Thomson-Houston arc machine. There are no gas works in the town.

The storage battery plant recently installed is situated midway between east and west sides on the line of the trolley road, about ¾ mile from the east side power house and ¼ mile from centre of the west side light distribution.

The plant consists of 240 chloride accumulators with a capacity of 500 ampere hours at a 50-ampere rate of discharge. The batteries are divided into four series of 60 cells each, connected to a switchboard and so arranged that cells may be connected to the railway, 240 in series, or to lighting circuits in two parallel series of 60 cells each, one on each side of the 3-wire system; they are thus capable of supplying nominally 400 16-cp lamps for ten hours, or at the maximum rate of discharge, 600 lamps. An independent feeder

* A paper read before the Northwestern Electrical Association, Jan. 17, 1895.

connects the battery with the east side power house ¼ mile distant. A variable resistance is placed in circuit between the battery and the railway so that when the battery is fully charged, requiring a voltage of 600, the voltage on the railway circuit may be cut down if necessary.

The operation of the east side lighting and the night running of cars (or rather car) was most unsatisfactory before the battery plant was installed. Owing to lack of power it was necessary to couple together railway and lighting water wheels, so that the slightest variation in the railway demands was apparent in light. Only one car could be run during lighting hours.

That the dwellers in Merrill, east side, should consider electric lighting a failure under these conditions, and that the traveler in the slow, dimly lighted car sighed for the return of the ancient horse car, is not to be wondered at. On Jan. 4, 1895, the battery was connected to the railway circuit. The great improvement in the running of cars was immediately noted by all, but it was at night that the contrast was most apparent. The two water wheels were connected together as usual, but the railway generator charged the battery at a steady rate of 20 amperes instead of running a car with its ever varying demand of from 0 to 120 amperes. Instead of one dimly-lighted, slow-running arc, two brilliantly lighted cars were operating at the highest speed allowable on the streets. Instead of a succession of sharp peaks the voltage "curve" of lighting circuit became practically a straight line; instead of 9 volts variation on each side of three-wire system, as at first, there is practically no variation, demonstrating most clearly the capability of the battery to respond to all demands of railway, no matter how severe. On several occasions the two cars were operated by the battery alone for several hours at a stretch, thus allowing in the daytime the entire shutting down of the power plant and, at night, the use of the two water wheels exclusively for lighting.

The company intends to increase its power at the east side plant by the addition of a wheel to operate the railway generator. By this addition the two wheels now in use may be utilized for east side lighting while the battery carries the west side incandescent lighting. The battery will be charged during the day, as at present, from the railway generator, at the same time keeping voltage even on railway circuit. This plan will enable the company to do away entirely with the west side steam plant, there being surplus water power sufficient to run the arc and 500 volt incandescent machines now at the west side.

Electrical Medical Apparatus.

BY HARRY F. WAITE.

Faradic Apparatus.

MUCH improvement has recently taken place in faradic medical apparatus, for it is only a few years since all that a physician required of a faradic battery was that it should be strong enough to twist the patient all out of shape and sing loudly. It did not make any difference whether the current was smooth or jerky as long as it had the above requirements; in fact, the laity imagined that they were not being properly treated unless the current was strong enough to hurt. Now it is just the other way. What a physician requires most in a faradic battery is that the current be absolutely smooth and not jerky, and that the vibrator make as little noise as possible.

The general construction of a faradic is about the same as it has

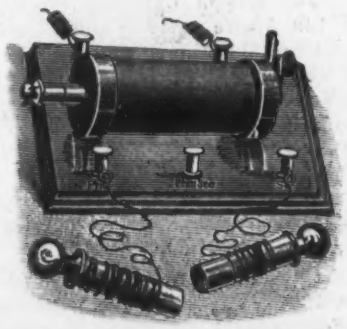


FIG. 1.—SMALL MEDICAL COIL.

always been, except the secondary coil. Fig. 1 shows what is called a "Medical Coil," the construction of which is shown in Fig. 2, P, P_1 being the primary and S, S_1 the secondary circuits. Experiment has taught that in order to get the best results it is necessary to have three separate secondary coils. Winding the three coils on one spool will not answer, for the following reasons: First, one of the coils will have to be at least an inch away from

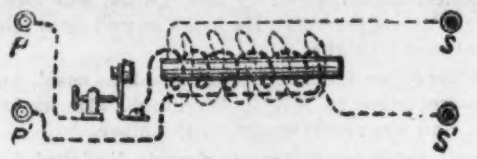


FIG. 2.—CIRCUITS OF MEDICAL COIL.

the primary coil, so that in order to get a strong current from this coil you will have to use an unnecessarily large current in the primary circuit, so large that it will in a very short time burn out the platinum on the vibrator at A in cut. Second, by having

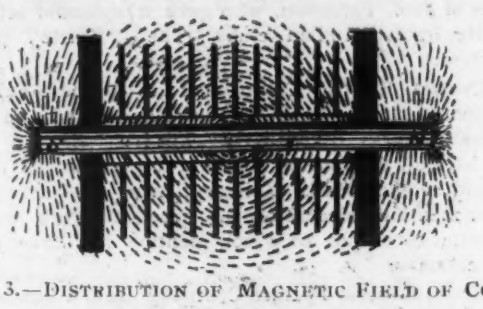
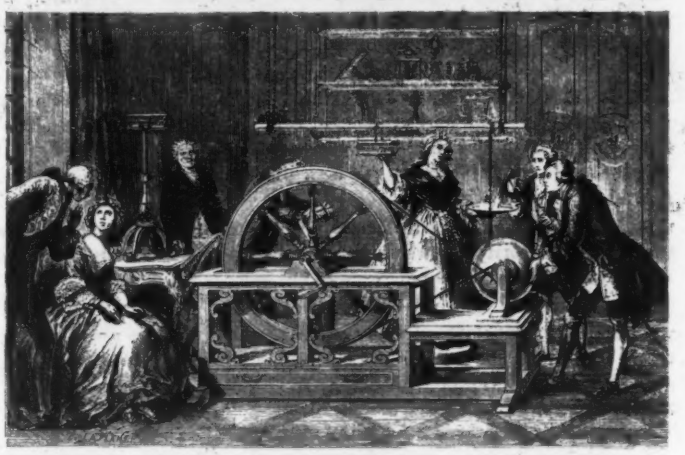


FIG. 3.—DISTRIBUTION OF MAGNETIC FIELD OF COIL.

the coil so large in diameter we only get half the number of turns for the same length of wire, so that the electromotive force is much less. To illustrate, suppose 100 feet of wire is wound on a



[FIG. 4.—ONE OF THE FIRST FORMS OF THE STATIC MACHINE.

spool one inch in diameter and the same amount on another two inches in diameter; it is easily seen that there will be twice as many turns on the first as on the second, because 3.14 inches

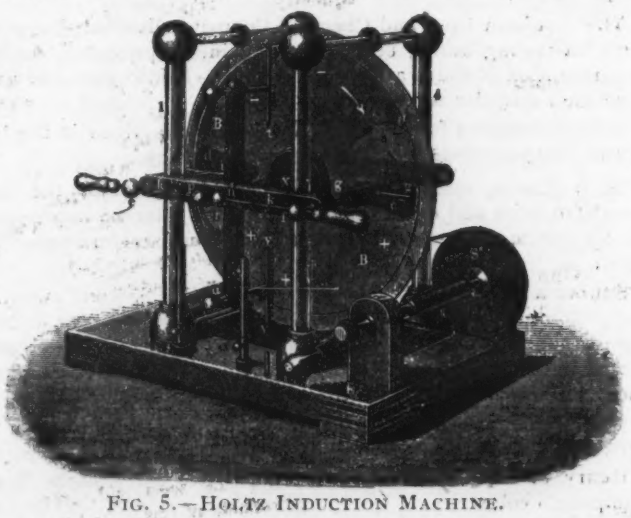


FIG. 5.—HOLTZ INDUCTION MACHINE.

will make one turn on the former and only a half turn on the latter. From Fig 3, which shows the distribution of the magnetic field in a secondary coil, it will be seen that if the strength of the primary current is the same for both coils, the coils named, the

one with a small core will give a greater quantity than the other, as the magnetic field is much stronger in it. The most perfect faradic apparatus made to-day is one which will give from one to one hundred and fifty thousand vibrations per minute and count them. The counting is a most important point, as it is an acknowledged fact that different nervous diseases have different rates of nerve vibration.

Static Apparatus.

There is a great difference in the appearance of the modern static machine, and the machine as it was made over one hundred years ago. Fig. 4 shows one of the first forms of static apparatus. Then came the Holtz induction machine (Fig. 5), and although this model was a great improvement still one could not depend upon it to al-

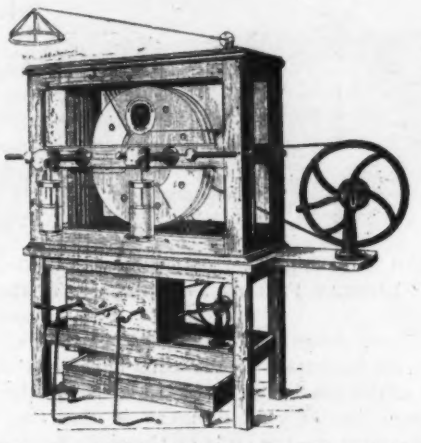


FIG. 6.—A MODERN STATIC MACHINE.

ways work. Dr. A. L. Ranney was the first to enclose all the working parts in a practically airtight case, and by so doing make a practical machine and one that can be relied upon to always work. A first class machine should give a spark of from ten to twelve inches. The number of plates has nothing to do with the length of spark—that depends entirely upon the diameter of the circle. Fig. 6 shows a modern static machine. A machine that will give a twelve-inch spark has an electromotive force of 247,000 volts, but owing to its enormous internal resistance, which is about 247,000,000,000 ohms, it is a perfectly safe current. There is nothing equal to static electricity as a remedy for nervous diseases.

Electrical Power Transmission.—X.

BY LOUIS BELL, PH. D.

The transmission of power to series wound motors at constant potential is a branch of the art which as regards stationary motors has been developed only in special cases. It is, however, the method universally employed for electric railway work. One or two sporadic efforts have been made to operate electric railway systems at constant current, but with such indifferent success that the method has been abandoned.

Counting in electric railways, it is safe to say that at present the majority of all electrical power transmission in the world is done with series motors worked at constant potential or as nearly constant potential as may be practicable. As before mentioned, regulation is generally obtained through the use of rheostats in series with the motors, thereby cutting down the applied voltage, or by throwing the motors either in parallel or in series with each other, or in the third place by a combination of the above methods. Concerning the operation of motors thus arranged, sufficient has been said to explain the situation clearly. The general good properties of the method are most prominently exhibited in the simplicity of the motor windings and the very powerful effort which can be obtained in starting the motors from rest. These properties are of extreme value in railway service.

Aside from the operation of electric railways, series motors at constant potential are frequently employed for hoists and similar work where a powerful starting torque and considerable range of speed at the will of the operator are desirable. In spite of the considerable use of motors for such purposes there are no plants either here or abroad which may be said to be operated exclusively after this method, for it is generally found desirable to combine in the same system series wound motors for severe work and shunt wound motors for purposes where uniform speed is of prime importance. As a rule the power transmission so accomplished is over a comparatively small distance and really involves the problem of distribution more than transmission alone. A considerable number of electric hoists designed by different makers are in use at various points throughout this and other countries, doing service in mines, operating elevators of one kind or another, working derricks and traveling cranes and a large variety of similar purposes. Many of the motors employed are of the railway type.

The voltage employed for this work in America at least is usually either 200 to 250 volts or 500 to 600 volts, the former being most generally used in mines, where difficulties of insulation are considerable, or in operating motors supplied by three-wire systems already installed. The latter voltage is generally selected for work above ground. None of the plants so equipped are, however, sufficiently large or characteristic to be worth a detailed description. The power installations and method of distribution are in general closely similar to those employed for electric railway work. Plants of higher voltage than from five to six hundred are so infrequent as to be hardly worth considering in practical engineering. It is perfectly possible to wind series motors for voltages considerably exceeding this figure, say for 1,000 or 1,200 volts, or, in rare cases, more, provided the units are of tolerable size, but inasmuch as most plants for the distribution of power require both large and small motors, wound both series and shunt, the general voltage is in nearly every case kept at a point at which it will be easy to meet these varied requirements; therefore 500 volts, the American standard for railway practice, has been usually selected.

The only noteworthy exceptions may be found in the use of the Edison three-wire system for distribution of power to railway and other motors. By this method it becomes possible to transmit the power at the virtual voltage of 1,000 and to employ 1,000-volt motors, either series or shunt wound, for the larger units in order to help in preserving the general balance, while at the same time using motors of all sizes wtih any kind of direct current winding, connected between the middle wire and either of the outside wires. The advantages of such an arrangement are very evident, and if the number of motors be considerable, so that it is possible to balance the system with a fair degree of accuracy, we have at our disposal a very convenient method for the distribution of continuous currents. It is interesting to note that this scheme found its first considerable development in electric railway service itself. Of course the use of both 110 and 220 volt motors on Edison three-wire systems is comparatively common, but the extension of the plan of operating electric roads, even under conditions which as regards balance are somewhat trying, is a considerable advance in the art of continuous current transmission.

The method of working electric railway on the three wire system is well shown in Fig. 25. Here the road is a double track one to

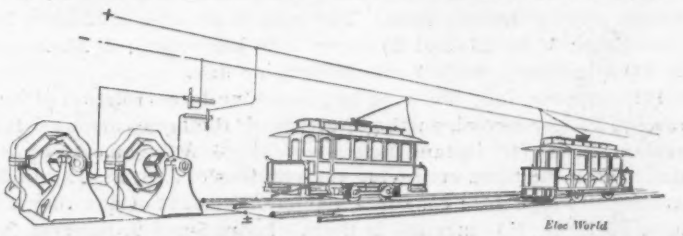


FIG. 25.—ARRANGEMENT OF APPARATUS FOR THREE-WIRE RAILWAY SYSTEM.

which the method is generally best adapted. The ground and supplementary wire serve as a neutral wire, both tracks being placed in parallel for this purpose and thoroughly bonded. On a double track road, the cars running on each side of the system will be substantially the same in number, and if the total number of cars be considerable, a very fair balance can be obtained, although never probably as good as is customarily and necessarily used in an Edison three wire system for lighting. In order to still futher improve the balance of the system and prevent its being disturbed as might otherwise occur by a blockade on one track at some point, it is better to make the trolley wire above each track consist of sections of alternate polarity and of convenient length, so that even in case of a blockade, stopping a considerable number of cars, the load would be removed almost equally from both sides of the system. Installed in this way, a railway system is operated at a virtual voltage of 1,000, and the saving of copper over the ordinary distribution at 500 volts is very considerable in spite of the inevitable lack of balance, particularly in small roads, demanding a neutral wire of more than usual capacity. The total amount of copper required for such a system at 1,000 volts between the outside wires, making a liberal allowance for the neutral wire, which in this case means through bonding and supplementary wires for the tracks, is not much, if

any, in excess of 40 per cent. of the copper required in an ordinary railway system at 500 volts. The advantage, especially in the case of long lines, is obviously very great. The three wire method is not necessarily confined to double track roads, as even where only a single track is employed various sections or branches of it may be linked together to form a fairly well balanced three wire system. It is interesting to note that this plan has been in use in several American street railway plants for the past few years, notably at Bangor, Maine, and at Portland, Ore., at both of which places power is transmitted over long feeders from central stations operated by water power. Very recently, the serious trouble which has been caused on many large electric railway systems by the electrolytic action of the current on gas and water pipes has brought the three wire system into prominence, all questions of transmission aside. It is obvious that where the earth and rail are only used as a neutral wire, the stray currents are comparatively small, while in an ordinary grounded system the earth and rail return has to take care of the entire current used, and the almost inevitable result is electrolytic action of more or less severity on cables and pipes running in the vicinity of the tracks. Apart from railway service, the three wire distribution has been but very little used for power transmission purposes either here or abroad, but no particular difficulties are involved, and it occasionally may prove a very serviceable method for the transmission and distribution of power over moderate distances.

(To be continued.)

Electrodynamic Machinery.—XXIII.

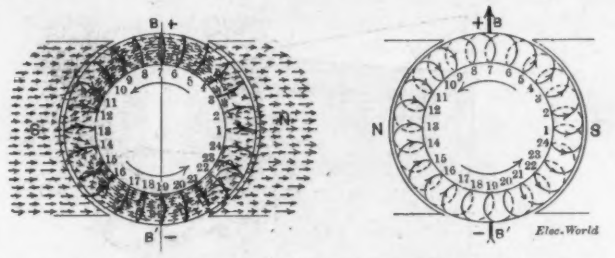
BY EDWIN J. HOUSTON AND A. E. KENNELLY.

111. The armature of the dynamo electric machine which comes next in order of complexity was that devised by Gramme, and now known generally as the Gramme ring armature. This armature, as its name indicates, belongs to the type of ring armatures, and consists essentially of a ring-shaped laminated iron core wound with coils of insulated wire. A simple ring of iron, Fig. 96, wound with 24 separate turns of wire, is placed so as to be able to revolve about its axis in the bipolar field N, S. Considering the ring to be first at rest, the turns 6, 7, 8, 18, 19 and 20 are represented as being linked with the total flux passing through the cross section of the ring. If the total flux entering the armature at the north pole and leaving at the south pole, that is, passing from N, to S, be two megawebers, then one megaweber passes through the upper half of the ring, and one megaweber through the lower half. The loops 5, 9, 17 and 21 are diagrammatically represented as having 900 kilowebers passing through them. The loops 4, 10, 16 and 22 carry 700 kilowebers; 3, 11, 15 and 23 carry 500 kilowebers; 2, 12, 14 and 24 300 kilowebers, while 1 and 13 carry no flux.

112. Suppose now, the ring be given a uniform rotation of one revolution per second, in the direction of the large arrows. It is evident that at any instant there is no change in the amount of flux linked with the turns occupying the positions 6, 7, 8, 18, 19 and 20; so that, although these contain a maximum amount of flux they will have no E. M. F. generated in them. Loops 5 and 9, however, are in a position at which the flux they contain is changing; that is to say, the amount of flux that is passing through them at each instant has neither reached a maximum nor a minimum; and the same is true with regard to the loops 17 and 21. In 5, the flux is increasing, and in 9, it is decreasing; consequently, the E. M. F. in 5 is directed oppositely to that in 9, and, according to rule, is indicated by the curved arrows (Sec. 90); for, if coil 5 be regarded by an observer facing it from S, the flux, as the ring moves on, will thread the loop in the same direction as the light coming from the face of the loop to the observer considered as a watch dial, and the E. M. F. generated in the loop will be directed counter-clockwise, while the E. M. F. in the loop 9 must have the opposite direction. Moreover, similar reasoning will show that all the coils to the left of the line BB', that have E. M. Fs. generated in them, will have these E. M. Fs. similarly directed; *i. e.*, outwards, as shown, while all on the left hand side of the line will have the E. M. Fs. also similarly directed, but inwards. Loops 1 and 13, which lie parallel to the direction of the flux, will, in the position shown, have no flux threading through them, but during rotation the rate of change of flux linked with them is a maximum, consequently the E. M. F. induced in them is a maximum.

113. Instead of conceiving separate conducting loops to be wound on the surface of the armature, as shown in Fig. 96, let us suppose a continuous coil is wound on the surface of the armature as shown in Fig. 97, the first and last ends of the coils being connected together so as to make the winding continuous, then it is evident that the E. M Fs. so acting in the coil, being similarly directed on each side of the vertical line BB', might be made to produce a continuous E. M. F. in the conducting wire which would be oppositely directed in the coils lying to the right of the line BB' from what it is in those lying to the left of the line BB', and that, moreover, if two wires, or collecting brushes, were employed in the positions BB', the E. M. Fs. from the two halves of the ring would unite at the brushes BB'.

Such a condition finds its analogue in the E. M. Fs. produced by two series-connected voltaic batteries connected as shown in Fig. 98, with their positive poles united at B, and their negative poles



Figs. 96 and 97.—Diagram of Gramme Ring Armature in Bipolar Field. 24 Separate Turns.

at B'. The figure shows two batteries of 9 cells each connected in series. Here, as indicated, all the cells have equal E. M. F. This condition of affairs need not, however, exist in the Gramme ring analogue, since the only requirement is that the sum of all the E. M. Fs. generated in the coils on the right hand side be equal to the sum of those on the left hand side. In point of fact, as already observed, the E. M. Fs. are not the same in each of the coils, those at 1 and 13 having a maximum, and those at 7 and 19 having zero E. M. F. Since these oppositely directed E. M. Fs. balance each other, no current will be produced in the armature unless an external circuit be provided, joining the brushes BB'.

114. Diagram 96 shows no difference between the amount of flux threaded through the coils 6, 7 and 8 or 18, 19 and 20, and, consequently, according to theory the total absence of induced E. M. F. In practice, however, owing to leakage (Sec. 68) and other causes, no coil is entirely free from E. M. F. generated in it.

Moreover, the difference in the E. M. F. generated in coils 13, 12, 11 and 10 is not as great as might be inferred from their angular position on the armature, owing to the fact that (Sec. 86) the flux enters the armature core nearly uniformly all around its surface.

In order to determine the total E. M. F. generated in such an armature as is represented in Fig. 97, it is first necessary to determine the E. M. F. generated in a single turn. Considering a turn starting from the position 7, and, therefore, containing no flux, being carried by the uniform rotation of the armature in the direction of the arrows to the position 19 in a time t seconds, during this time the flux threading through it changes from $\frac{\Phi}{2}$ webers in one direction to $\frac{\Phi}{2}$ webers in the opposite direction and, therefore, the change in flux linkage will be ϕ webers, ϕ being the total flux passing from N into S, through the armature. Whatever may be the distribution of flux through the armature and in the air gap, the average E. M. F. generated in the coil during this time will be $\frac{\phi}{t}$ C. G. S. units of E. M. F. If the number of revolutions made by the armature per second be n, then one revolution takes place in the $\frac{1}{n}$th of a second, and a half revolution in the $\frac{1}{2n}$th of a second, so that $t = \frac{1}{2n}$ and the average E. M. F. is

$$\frac{\phi}{\frac{1}{2n}} = 2n\,\phi$$

115. If, for example, the armature be revolved at a speed of 600 revolutions per minute or 10 revolutions per second $n = 10$, and since ϕ has been assumed to be 2 megawebers, the average E. M. F. generated in any loop in passing from the position 7, to the position 19, will be $20 \times 2{,}000{,}000 = 40{,}000{,}000$ C. G. S. units, or 0.4 volt (Sec. 71). The same E. M. F., oppositely directed, however, will exist on the average in any turn on the right hand side of the line BB'. If the ring were wound with only four turns, say 1, 7, 13 and 19, the E. M. F. generated in these turns when placed in series and con-

nected to the brushes B and B' would evidently fluctuate considerably, since when the coils occupy the position shown, the E. M. Fs. would be a maximum in 1 and 13, and be zero in 7 and 19, while, after ⅛ of a revolution, all four coils would be active. If, however,

FIG. 98.—VOLTAIC ANALOGUE OF E. M. Fs. GENERATED IN GRAMME RING.

numerous turns are wound on the coil, it is evident that the total E. M. F. between the brushes B and B' will be very nearly uniform, since the only fluctuation which can take place is that coincident with the transfer of a single turn beneath the brush; consequently, in order to determine the total E. M. F. generated by the rotation of a Gramme ring armature, it is only necessary to multiply the average E. M. F. in each turn by half the number of turns on the armature; *i. e.*, by the number of turns active between B and B' on each side, so that if w be the number of turns on the armature counted once around, $\frac{w}{2}$ will be the number of turns active between brush and brush, and the total E. M. F. on each side of the armature will be

$$2\Phi n x \frac{w}{2} = \Phi\, n\, w \text{ C.G.S. units} = \frac{\phi\, n\, w}{100,000,000} \text{ volts.}$$

If $w = 24$, as in the case represented, then the total E. M. F. will be $2,000,000 \times 10 \times 24 = 480,000,000 = 4.8$ volts.

Laboratory of Houston and Kennelly, Philadelphia.

(To be continued.)

Practical Notes on Dynamo Calculation.—XXIV.

BY ALFRED E. WIENER.

If two magnets furnish the magnetic flux they are placed concentric to the armature and the two sets of polepieces so arranged that adjacent poles on either side of the armature are of unlike polarity, but that poles facing each other on opposite sides of the armature have the same polarity. Such a *Double Magnet Multipolar Type* is shown in Fig. 96; it is that designed by Lundell, and built by the Interior Conduit and Insulation Company, New York.

In giving the yoke of the Radial Multipolar Type (Fig. 88) such a shape as to form a polepiece between each two consecutive magnets an iron clad form is obtained having alternate valient and consequent poles, and requiring but one-half the number of magnets as a Radial Multipolar Machine of same number of poles.

Fig. 97 shows a field-frame of the *Multipolar Iron Clad Type*, having six poles, which is the form employed in the Gearless Street Car Motor of the Short Electric Railway Company, Cleveland, O. In Figs. 98 and 99, two special cases of this type are depicted, both representing, *Fourpolar Iron Clad Types*, and differing only in the position of the magnets. The *Horizontal Fourpolar Iron Clad Type*, Fig. 98, is used in the Edison Iron Clad Motor (General Electric Company), and in the dynamos of the Wenstrom Electric Company, Baltimore, Md. The *Vertical Fourpolar Iron Clad Type*, Fig. 99, is employed by the Elliott-Lincoln Electric Company, Cleveland, O.

Fig. 100 shows a special case of the Horizontal Fourpolar Iron Clad Type, obtained by symmetrically doubling the frame illustrated in Fig. 84, and providing four poles instead of two. The cores are so wound that the centre of the cylindrical iron wrappage has one polarity and the ends the opposite polarity. Two oppositely situated polepieces are joined to the middle, and the two sets of intermediate ones to the ends of the magnet-frame; the lower half of Fig. 100, consequently, is a section taken at right angles to the upper half, the diametrically opposite section being identical. This type has been developed by the Storey Motor and Tool Company, New York.

Multipolar fields may also be formed by a number of independent horseshoes arranged symmetrically around the outer armature periphery. Figs. 101 and 102 show two such *Multiple Horseshoe Types*, double magnet horseshoes being employed in the former and single magnet horseshoes in the latter type. Multiple horseshoe machines of the double-magnet form (Fig. 101) have been designed by Elphinstone & Vincent, and by Ellwell-Parker Electro-Construction Corporation, England; while the single-magnet form (Fig. 102) is employed by the Electron Manufacturing Company, (Perret), Springfield, Mass.

Further forms of multipolar fields can be derived from the bipolar horizontal and vertical double-magnet types, respectively. If, in the Vertical Double Magnet Type, Fig. 76, an additional polepiece is provided at the centre of the frame so as to face the internal surface of the armature at right angles to the outer polepieces, the *Fourpolar Vertical Double Magnet Type* is created, which, when laid on its side, will constitute the *Fourpolar Horizontal Double Magnet Type*, Fig. 103. If, in the Vertical Double Magnet Type, Fig. 78, the two cores are cut in halves and additional polepieces inserted at right angles to the existing ones, the *Vertical Quadruple Magnet Type*, Fig. 104, is obtained; the same operation performed with the Horizontal Double Magnet Type (77) will give the *Horizontal Quadruple Magnet Type.*

Fourpolar Horizontal Double Magnet Dynamos are (Fig. 103) built by the Zurich Telephone Company, Zurich, Switzerland; and Vertical, Quadruple Magnet Machine (Fig. 101) by the Duplex Electric Company, Corry, Pa.

Numerous other multipolar types have been invented and patented, but have not yet come into practical use.

Chapter 42 —Selection of Type.

If the type is not specified, the field magnet frame for a large output machine should be chosen of one of the *multipolar types*, as in these the advantage of a better proportioning and a higher efficiency of the armature-winding, and the possibility of a symmetrical arrangement of the magnetic frame results in a saving of copper as well as of iron; while for smaller machines —below 10 kilowatts capacity—the *bipolar forms* are preferable on account of the great complication caused by the increased number of armature sections, commutator divisions, field coils, etc., necessary in multipolar machines, and on account of the narrowness of the neutral or non-sparking space on a multipolar commutator.

The field, moreover, should have as few separate magnetic circuits as possible; thus in the case of a bipolar type, it should be a single magnetic circuit rather than the consequent pole type which is formed by two or more magnetic circuits, of one or two magnets each, in parallel, because the former is more economical in wire and in current required for excitation. In two-circuit consequent pole machines, for instance, such as the Double Magnet types, Figs. 77, 79 and 80, and the Double Horseshoe types, Figs. 81 and 82, according to Table LIII., Chapter 43, there is 1.41 times the length of wire, and consequently also 1.41 times the energy of magnetization required than in a single circuit, round cores being used in both cases, and the single circuit having exactly twice the area as each of the two parallel circuits in the consequent pole machines. Triple and quadruple magnetic circuits, *i. e.*, 3 or 4 cores, or sets of cores, magnetically in parallel, are still more objectionable, requiring, when the cores are of circular cross-section, 1.73 and 2.00 times as much wire, respectively, as a single magnetic circuit having a round core of equal total sectional area.

If a machine has several magnetic circuits, each of which, however, passes through all the magnets in series, then the frame is to be considered as consisting of but one single circuit, for the subdivision only takes place in the yokes, and it is immaterial as to the length of exciting wire whether the return path of a single circuit is formed by one yoke, or by a number of yokes magnetically in parallel. The above-named objection to divided-circuit types, consequently, does not apply in the case of the Iron-Clad Forms, Figs. 83 to 87.

According to Table LII., Chapter 40, the Horizontal Double Magnet Type, Fig. 75, and the Horizontal Iron-Clad Type, Fig. 83, are the best bipolar forms, magnetically. The iron-clad types, furthermore, possess the mechanical advantage of having the field-windings and the armature protected from external injuries by the frame of the machines, which makes them eminently adaptable to motors for railway, mining and similar work.

The Inverted Horseshoe Type, Fig. 68, which ranks very highly, as far as its magnetic qualities are concerned, has the centre of its armature at a comparatively very great distance from the base, requiring very high pillow-blocks, which have to

carry the weight as well as the downward thrust of the armature inherent to the inverted forms having the field-windings below the centre of revolution; see chapter 24. The side pull of the belt with a high centre line of shaft tends to tip the machine, and the changes in the pull due even to the undulations of the belt will cause a tremor in the frame which jars the brushes and, eventually, loosens their holders, and which has a disastrous influence upon the wearing of the commutator. On this account the inverted forms, or "under-types" can only be used for small and medium-sized machines, in which the height of the pillow-blocks remains within practical limits.

In selecting a *multipolar* type, Table LII. shows that the Radial Innerpole Type. Fig. 89, offers the best advantage with regard to the magnetical disposition; with this type, however, are connected some mechanical difficulties, due to the necessity of supporting the frame from one of its ends, laterally, and the armature from the other.

In the outerpole types the armature core can be supported centrally from the inner circumference, and the frame suitably provided with external lugs or flanges resting upon the foundation, a most desirable arrangement for mechanical strength and convenience. The most favorite of the outerpole forms is the Radial Outerpole Type, Fig. 88, on account of its superiority, magnetically, over the Tangential and Axial Multipolar Types.

In all dynamo-designs the consideration is especially to be borne in mind that the whole machine as well as its various parts should be easily accessible for inspection, and so arranged that they can conveniently be removed for repair or exchange. A large number of machines owe their popularity chiefly to their good disposition in this respect.

The shape of the frame in all cases is preferably to be so chosen that the length of the magnetic circuit in the same is as short as possible.

(To be continued.)

Static Electricity and Printing.

To the Editor of The Electrical World:

Sir:—We notice in a recent issue an inquiry for some device to assist the pressman in dispelling the much abused electricity, so commonly present in all pressrooms during the winter months.

As we have had in the past an exasperating experience with electrification in our pressroom, and are now having no trouble whatever, we will endeavor to explain to your readers the means we have in use for ridding ourselves of that annoyance.

It is well recognized among pressmen that the output of the pressroom in the winter is greatly curtailed, and principally on account of the trouble with electricity, as manifested in offset or smutting, imperfect delivery, uneven piles on the delivery board, etc., necessitating, also, slower speed of the press.

The main principle of our device is the liberation of steam, in the form of vapor, immediately under the sheet of paper as it leaves the cylinder after being printed.

To do this we attach a perforated steam pipe to our heating system (we have a heating coil under each press, which makes the matter easy), and suspend it directly under the tapes of the delivery, from six to twelve inches from the same as the circumstances may direct, extending the pipe the full width of the press.

To prevent moisture from dripping on the form or rollers, a section of eave-trough, closed at the ends, is suspended under the perforated pipe, and to secure even distribution of the moisture a smaller trough is fastened in an inverted position over the pipe, thus preventing any blowing of the water or steam. A suitable drip pipe is attached to the lower trough to carry away surplus condensation.

We think the accompanying sketches will sufficiently illustrate the application of the device.

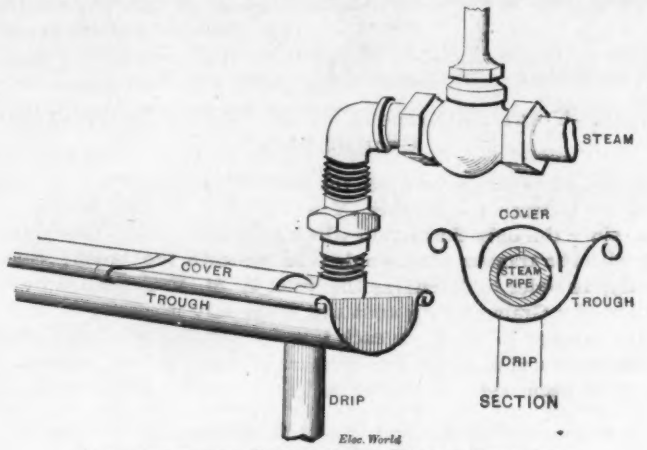
If the main principle is adhered to, of applying the moisture immediately under the sheet as it leaves the cylinder, a modification of this device may be applied to any press by an intelligent pressman, and avoid any further trouble with electricity.

Before applying this device to our presses we were greatly troubled with offset or smutting, failure of the sheet to leave the cylinder, etc., and the paper could not be made to deliver in even piles with the best of mechanical joggers, while the pressman often received severe shocks from the charge on the pile on the delivery load.

This may look like going to a great deal of trouble, and the machine may appear to the electrician as unscientific and crude, but a brief trial of it on one press will satisfy the most skeptical pressman of the perfect working of the scheme, even though there be no wires attached.

The amount of steam to be admitted is small and may be soon learned; enough to form a small cloud of vapor is sufficient.

There is no damage to the surface of the highest finished supercalendered paper, unless the press be stopped with a sheet directly over the steam. We also find no trouble with rusting of the machinery, as would be the case if the atmosphere of the room



Apparatus for Dissipating Static Charge.

were dampened to the same extent as it is directly under the sheet.

We have never attempted to solve the scientific theory of the operation of this device. Perhaps the more technical of your readers can.

Wm. C. Gage & Sons.

Battle Creek, Mich.

To the Editor of The Electrical World:

Sir:—The electricity in paper, of which many printers complain, is usually in the paper when it is received from the mill. No doubt the cylinder printing machine adds something to it.

We have tried these remedies: (1.) A continual wetting of the floor, and the production of a moist atmosphere; this is only a partial benefit. (2.) The attachment of copper wires leading from the paper to the floor; apparently of no benefit at all. (3.) Steaming the paper by allowing the steam to escape from a gas pipe pierced with little jets. This has been quite effectual. Mr. Morehouse, of New Haven, says that heated air accomplishes the same purpose. With his method he uses a hollow copper tube pierced with holes about one and one-half inches apart from which come flames about an inch high. This tube is put underneath the feedboard of a cylinder press, which sends a current of warm air upon the paper after it has been printed. He claims that this is entirely effectual.

Theo. L. De Vinne.

New York, N. Y.

Shunt vs. Compound-Wound Dynamos.

To the Editor of The Electrical World:

Sir:—In a recent number of The Electrical World I noticed an article on dynamos for power plants. The writer made the statement that most men in charge of power and lighting plants preferred shunt to compound-wound dynamos, considering it better to rely entirely upon hand regulation than placing dependence on the compound winding to accomplish the desired regulation. I did not suppose such to be the case at all in this country, although this idea does prevail to a large extent in Englaud.

It would seem that the use of compound winding is analogous to the use of the governor on a steam engine. Of course, compound winding regulates only within certain limits. Attendants are needed to look after it occasionally, but such is the case with the engine governor as with any automatic system of regulator.

I have seen a Corliss engine slow down and almost stop when a large load was suddenly thrown upon it. It would have stopped entirely had not the engineer opened the valves and admitted more steam. Yet they continue to use the same governor.

It must require an immense amount of labor in a large plant equipped with shunt machines to keep good regulation when the load is constantly varying. It there is a nearly constant load a shunt machine is all right. A well designed compound machine will regulate well except in case of a sudden and large change in load.

Cleveland, O. F. T. Carlton.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors or publishers are solicited, and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 922 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Constructing Small Dynamos.—The article mentioned in the Digest last week is continued in the Lond. "Elec. Rev.," Jan. 4. Besides the specific dimensions of the machine, some general figures and recommendations are also given.

Small Motor.—An illustrated article intended for armatures, describing the construction of a very small motor, is published in "L'Elec.," Jan. 5.

Unipolar Machine.—Another article by Mr. Ziegenberg is contained in the "Elek. Anz.," Dec. 23. As the direct and the counter E. M. Fs. in many forms of proposed unipolar machines are equal, thereby producing no voltage, he suggests making the latter less than the former, thereby obtaining a useful difference; this he (erroneously) believes can be done by having a different field or speed at the part of the circuit where the counter E. M. F. is generated. He states that in an ordinary Gramme ring machine a current will circulate in the two parts of the winding if the machine is not well constructed, and by increasing these errors in its construction he believes this difference can be made very great (but is not this current an alternating one?); a diagram of such a proposed machine is given (his error lies in the fact that he forgets that precisely as many lines of force leave the armature as there are entering it, and that the speed must be calculated in revolutions per second, which is the same for all parts of the armature); he claims to have made some tests in which currents were produced (these tests, however, are not conclusive, as they do not appear to represent the true conditions). He also suggests reversing the counter E. M. F., thus making both useful; this he thinks may be done by rotating one annular magnet in one direction on one side of two flat-ring armatures, and another oppositely polarized magnet in the other direction on the other side of this armature (if the lines of force ended abruptly in the iron core of the armature, which they do not, this would undoubtedly work very well); he assumes that the lines of force will rotate with the iron and the coil of the magnet which generates them; he admits, however, that the result is somewhat doubtful.

Electricity in Mining.—The serial by Mr. Berthon is continued in "L'Elec.," Dec. 29; he discusses electric pumps.

Constant Speed Motors.—The "Elec. Age," Jan. 19, contains an article by Mr. Fay, in which he discusses shunt motors in which the speed must be absolutely constant, for use, for instance, in silk mills where a variation of 4 to 5 per cent. is quite out of the question; he believes it will be superseded by the compound motor. He gives some diagrams showing the variations in speed of a number of different motors; for a three-hp motor there was a change of speed of 16.67 per cent. between no load cold and no load hot; this must be due to the heat of the field coils; between no load hot and full load hot the speed fell 10 per cent., which was due to the heating of the armature; similar results are given for a number of different motors.

Dynamo Design.—In a continuation of Mr. Harrison's serial in the "Elec. Age," Jan. 19, he discusses magnetic leakage and reprints Mr. Wiener's recently published table giving the factor of leakage for various types and sizes of dynamos.

LIGHTS AND LIGHTING.

The Light of the Future.—The Lond. "Elec. Rev.," Jan. 4, contains an article by Mr. Gray on this subject. He discusses the recent researches of Ebert, and examines whether they are necessarily inconsistent with what is already known. According to Langley 2.4 per cent. of the radiant energy in the spectrum of an Argand gas flame lies in the visible part, and he assumed that only 25 per cent. of the total energy produced by combustion took the form of radiant energy; Thomsen found that only 15 per cent. appeared as radiant energy, which with 2.4 per cent. gives 0.36 per cent. as the ratio of energy producing light, to the total energy of combustion in the Argand gas flame; assuming that the efficiency of the amyl acetate flame is about the same as that of oil or gas, it is theoretically possible for a lamp converting all the energy into luminous radiation to produce 280 times more light than the amyl acetate flame for the same expenditure of energy. Ebert found that his lamp gave 1,500 to 2,000 times more light than the amyl acetate lamp or from 5 to 7 times more than would be theoretically possible provided the same rate of expenditure of energy in the luminous part of the radiation produced the same candle power; experiments by Merritt (Amer. Jour. of Sc. vol. 37, p. 167) with the incandescent lamp show that the ratio of the expenditure of energy of luminous radiation to the candle power is by no means constant; there is nothing, therefore, inconsistent with these results in supposing that a given expenditure of luminous energy in the luminescent lamp produces 5 to 7 times greater intensity of light than the same amount of energy produces in the amyl acetate flame; the extraordinary efficiency of Ebert's lamp is, therefore, theoretically possible; he finds that the Argand flame, the amyl acetate lamp and incandescent electric light all give about the same candle power per watt of luminous energy; the ratio of the luminous energy to the total energy in the electric lamp giving 16 cp is, according to Merritt, .054, while in the amyl acetate lamp it is .0036: it is, therefore, 15 times as great in the former as in the latter, and one can, therefore, only expect about 100 cp in the luminescent lamp for 1 cp in the incandescent lamp.

Silvered Bulbs.—In an article in the "Zeit. f. Beleucht.," Dec. 30, the effects of silvering one-half of the bulbs, on the economy in lighting, is discussed. Two lamps were tested for candle power, first with the reflector and then after removing the silver coating; in the first case they gave 40 and 45 cp, and in the second case 16.9 and 17.3, measured in the direction of the axis of the reflector; this corresponds in one case to 3.488 watts per candle without reflector and 1.473 with reflector; for the second lamp 3.559 without and 1.368 with reflector. A table gives the total cost of power and lamps for 1,000 hours for different candle powers, with and without the reflector, which shows that with the usual incandescent lamp 375 hours cost as much as 1,000 hours with the reflector (this of course refers to the light in the direction of the axis of the reflector and not to the total diffused light).

Construction of Incandescent Lamps.—An article by Mr. Krueger is begun in the "Zeit. f. Beleucht.," Dec. 30; he intends to describe the lamp construction of different systems; in the present portion the "Seel" lamp is described.

POWER AND HEAT.

Diphase Transmission Plant.—A brief abstract of a description of a diphase plant installed at a French factory is given in the Lond. "Elec. Rev." and "Elec.," Jan. 4.

Cooking by Electricity.—Lond. "Lightning," Dec. 27, contains an article by Mr. Dowsing on this subject.

Operating Ships' Turrets.—An article is begun in Lond. "Engineering," Dec. 4, describing the installations on the new French cruiser Latouche Treville, and on the Chilian cruiser Capt. Prat, in which all the operations of working the guns and manœuvring the turrets are performed by electricity.

Transmission of Power.—The "Sch. of Mines Quart." for November contains an interesting paper by Mr. Self on "Electricity for Mining Plants," which, though referring more particularly to mining plants, is also of general interest. He considers only the question of the cost of generating the motive power at the mine (not including coal mines, of course, and that for transmitting it electrically from a distance. He takes the case of a mine the power for which is generated from wood fuel cut from the neighboring forests, and he finds that for a plant using 500 hp the total annual destruction of the forest exceeds 10,100 cords, or at 60 cords per acre this is equal to 167 acres per year; at the end of 10 years this means an area of 1 mile wide and 2.6 miles long; at a cost of $4 per cord at the mine, the total expenditure for power will be $75 per hp per year. He then calculates in a general way how far one may be justified in transmitting the power electrically to the mine. Since the cost of the generating and receiving plants will be substantially the same whether they are one or 50 miles apart, the problem becomes one of a determination of the possible distance over which it will pay to transmit the power. He develops a very simple general equation in which he substitutes the above mentioned cost for the power at the mine and from it obtains the number of dollars which may be spent for

conductors and still keep the final total cost per hp per year the same; this he finds to be $312,500; after fixing upon the E. M. F. to be allowed and the per cent. loss on the line it is then a small matter to find the distance; for financial reasons it is unwise to spend such a large amount for copper, but assuming $50,000 and a 20 per cent. drop it will pay to secure and improve by storage reservoirs or otherwise, any waterfall within a radius of nearly 14 miles for 2,000 volts, or 21 miles for 3,000 volts. By assuming the amount to be expended for pole line, etc., and substituting in this equation, one can determine the value of the electrical plant in the price of wood per cord or coal per ton; the difference between the actual cost of fuel and the so-calculated cost may be taken as a convenient measure of the advantages of electricity over steam.

Proposed Transmission Plant.—A plant has been proposed to utilize the power of the Cedar River, Washington, some distance east of Seattle, the calculated power of which is 54,590 hp for 12 hours per day. A brief description is published in the "Eng. News," Jan. 17, but it refers entirely to the civil engineering features; in order to regulate the speed a differential governor is used driven by an independent source of power; the company proposes to sell the power at ¼ of a cent per hp hour, which represents an average saving of about 35 per cent. on the present cost of 13 separate power plants in that city.

Estimates for a proposed plant near Seattle are given in the "Elec. Eng.," Jan. 16. The power is that of the Snoqualmie Falls, Washington, 23 miles east of Seattle; it is 286 feet high and its theoretical capacity is 51,607 hp; it is intended to deliver about 5,000 hp at Seattle at $30 per hp; the Westinghouse Company has made an offer for the whole plant, at $350,000.

Niagara Falls Plant.—A short article in the "Elec. Eng.," Jan 16, gives some illustrations of the present plant, a previously published description of one of the alternators, and the recent letter of Prof. Forbes.

Tree-Felling Machine.—"Cassier's Mag." for Jan. contains an illustrated description of a machine made in Budapest in which a series of parallel holes are drilled by a simple portable device containing an electric motor.

TRACTION.

Accumulator Traction.—In a further communication of Mr. Epstein, in the Lond. "Elec. Rev.," Jan. 4, he states that the cost of renewals of the accumulator made by this company amounts to only 1.5 cents per car mile; that the outlay is much less in an accumulator system than with long distance transmission; that a battery reserve of 25 per cent. is ample, although 50 per cent. might be preferable; regarding the great cost of handling the batteries, which was recently stated to be very great, he states that a small road using only a limited number of cars, and presenting exceptionally unfavorable features, is no proper criterion, and that with light batteries this cost would be much reduced.

Accummulator Traction.—"Helios," Dec. 1, states that part of the tramways of Hagen, Germany, are to be equipped with copper-zinc accumulators; no further information is given except that they are claimed to be lighter and more durable than the lead accumulators.

Series Traction System.—In an article of a general character by Mr. Perry, in the Lond. "Elec.," Dec. 4, he discusses the relative merits of the series and multiple arc systems, pointing out the objections to the former, and its advantages; by the use of a system devised by himself he thinks that series traction has been rendered practical.

Electric Traction in Europe.—An article by Mr. Dawson is contained in the Lond. "Elec. Rev.," Jan. 4. He states that the working expenses of European trolley lines average considerably less than 11 cents per car mile, and the average ratio of operating expenses to receipts is well below 90 per cent.; that for the English horse car lines is 81 per cent., the working expenses being 19 cents. Germany has now 180 miles of track, with 630 cars, and more than 8,000 hp in operation, besides 230 miles additional, for which contracts have already been let. In Halle, Germany, there was one accident to every 88,638 car miles; on the Berlin horse railways there was one in every 41,625 car miles; in Boston it was 52,475.

The same journal contains an article by Mr. Holroyd Smith, on "The Present Position and Prospects of Electric Traction in This Country" (England). The article is general in character, and is chiefly of local interest.

A detailed discussion of the subject of the return circuit, by the same author, with numerous illustrations, is published in the "Bul. Ass. Ing. Elec. Montefiore," Dec. 15.

Electric Traction.—A long series of papers on this subject by Mr. Philip Dawson is begun in Lond. "Engineering," Dec. 4. The chief aim will be to describe briefly the present state of electric traction in the United States and Canada from data collected by himself during a recent visit to this country.

Light Railways in Belgium.—Major Addison's report to the Board of Trade on light railways in Belgium is published in the Lond. "Elec. Eng.," Jan. 4.

Municipal Ownership.—An editorial in the "Eng. News.," Jan. 17, argues in favor of municipal ownership of street railways; "the best available remedy within great cities seems to be municipal ownership of the whole street railway system, and its lease to operating corporations on terms just to both parties, but leaving the absolute control in the hands of the city authorities. This is the plan now on trial in Toronto and in Detroit; and it has been long enough on trial in the first named city to prove the wisdom of those who carried the plan through against powerful and interested opposition. There are objections to the plan, we will admit; but these are far outweighed by the objectionable features of the present general abuse of power obtained for nothing by the street railway companies which have grown to such colossal proportions during the past few years."

Supplementary Wire.—In an article by Mr. Wynkopp, in the "Elec. Eng.," Jan. 16, he argues against the use of the supplementary return circuit between the rails; he shows that the rail bonds may be made sufficiently conductive so that this wire will not be required, the chief objection, however, being that it lasts but a short time. If it be suppressed and employed partly in increasing the bond capacity to that of the rail, the resistance will be reduced quite appreciably, although only about half of the copper saved has been added to the bond, showing that there is actually a saving of about 666 pounds per thousand feet, while the resistance of the return circuit has been decreased.

Single Rail System.—A description, with an illustration (showing no details) of the Beecher single rail accumulator system at Waterport, N. Y. (see Digest, Jan. 19), is given in the "Elec. Eng.," Jan. 16. The car has 50 cells of chloride accumulators, and a 5 hp slow speed motor, the car weighing 4 tons without passengers; it will seat 24 persons; on a recent trial trip, with 23 passengers, a speed of 19 miles an hour was obtained with an expenditure of only 3¼ hp. A contract has been made to construct and equip a 4-mile road from Waterport to Lakeside, on which speeds of 40 miles an hour, including stops, are to be made; the structure is normally 12½ feet above the surface; water power is to be used.

Electric Traction.—A portion of the discussion of the recent Institution (Lond.) papers (all of which was abstracted in these columns) is reprinted in the "St. Ry. Gaz.," Jan. 12.

Horse Power for Car Propulsion.—A correction and some additions to the simple rules mentioned in the Digest last week are published in the "Eng. News," Jan. 17.

New York Rapid Transit System.—The "Eng. News," Jan. 17, contains a communication from Mr. Reno, in which he enumerates the advantages of using his system in place of the one proposed by Chief Engineer Parsons; he claims that by using this system the cost will be within the legal limit, and that by no other plan can this be done; the article discusses only the civil engineering features.

Washington and Baltimore Line.—According to a reprint from a Baltimore paper, in the "Elec. Age," Jan. 19, this road, the length of which is 27.5 miles, will cost about $1,000,000; it will be operated by the block signal system; 20 motors of 100 hp will be used covering the distance in about 35 minutes; there will be two stations of 1,000 hp each.

Ohio.—According to the "Am. Eng." for January, the president of the Ohio Road Commission of 1893 proposes to build a great network of about 4,000 miles of electric lines at about $5,000 per mile, all over Ohio at the public expense, the counties pay half and the State the remainder; there is a probability that the scheme will be brought before the next Ohio Legislature.

Jersey City.—An illustrated description of the Jersey City, Hoboken & Rutherford R. R. Co. is published in the "St. Ry. Gaz.," Jan. 12.

New Haven.—A detailed description of the power house of the Fairhaven & Westville R. R. is given in the "Elec. Eng.," Jan. 16.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Possible Improvements in the Supply of Electrical Energy.—The Lond. "Elec. Rev.," Jan. 4, contains an article by Mr. Ferranti on this subject, in which he points out the directions in which progress must be made. Continuous current stations generally show better results in the way of cheapness of supply, but they are always in districts of small areas, and are incapable of extension; they can therefore never bring the distribution of electric energy to the position which it will surely attain; the distribution of electrical energy must be done on a large scale to be commercial, and to obtain this a large area must be supplied, and from a site not in the congested heart of a big city; this points clearly to the use of the high tension alternating current system, which therefore is the only one that can completely meet the conditions which are absolutely necessary. Cables are now being made at moderate prices, capable of conducting such high pressures, so that the question of voltage becomes "almost negligible;" there is little improvement to be looked for in this direction; if the other apparatus will stand 5,000 instead of 2,000 volts this increased pressure could be supplied through cables costing practically the same money for the same sectional area; the one seriously weak point is the question of transformers, and it is principally in this direction that one must look for improvement; the distribution after transformation is also an important point, and incandescent lamps ought therefore to be increased in voltage, and there ought to be a better system of wiring; the apparatus at the generating station is far too complicated to be able to be run cheaply and it is often of inferior quality;

engineers and capitalists have still got to learn "that the best plant that money can buy is none too good for the purpose." Regarding the running economy he believes that it can be increased quite appreciably by superheating the steam to 450 or 500 degrees F.; there is no doubt that the internal combustion engine will be the cheapest and best motive power.

High vs. Low Pressure.—An article on this subject by Mr. Kennedy is contained in the Lond. "Elec. Rev.," Jan. 4. The only high pressure system which has survived, he states, is limited to that one in which substations are supplied, from which low pressure wires are used; he discusses the circumstances under which the advantages of high pressure are great enough to warrant its adoption; if the low pressure feeders do not cost more than 10 per cent. over and above the high pressure feeders, including transformers, chambers, switches, conduits, and rectifiers if necessary, then continuous currents should be used, because in the form of continuous current electrical energy is much more generally useful; when first laid down a high pressure system will cost much less than the other, but this difference will be less later on as the load increases; it is only when the cost of the added low pressure mains is taken into account, which are required when the distribution increases, that a true comparison between the costs can be made; the advent of an improved storage so that the plant could be worked 24 hours a day would "knock the bottom out of the whole alternating current plant;" in such a system the generating plant now in use would supply just about seven times the present annual output; the future for the alternating current system lies in large transmission plants, in which case two or three phase currents must be used. He discusses compressed air as a rival in this field, stating that wonderful progress had recently been made with it in Paris. According to Prof. Unwin, air compressed by 1,000 hp to 132.3 lbs. per square inch can be transmitted 20 miles in the 30-inch main with a loss of pressure of only 12 per cent., and an air motor at the distant end would give a brake hp of 641; under more favorable conditions it is possible to obtain a total efficiency of over 70 per cent. He also discusses luminescence and does not think high frequency is necessary to produce it, merely intensifies the effect; he believes that luminescence is an effect of harmonics; he thinks there is not the slightest doubt of the ultimate success of this principle as a means of lumination, "and that, too, before long;" he also thinks that it is quite possible that luminescence lamps may be made requiring no vacuum.

Accumulator Installation.—A system of Messrs. Siemens & Halske is described and illustrated in the "Elek. Anz.," Dec. 30. It refers to the case when two series of accumulators are used in connection with a three-wire system, in which the regulation becomes somewhat complicated during the charging. In the present system a double switch disconnects the neutral wire from the middle point of the battery when it is to be charged and inserts at that point the auxiliary dynamo for generating the extra voltage, the two batteries being then in series with their other ends still in connection with the mains and the main dynamos; in this way the cells are charged. This auxiliary dynamo may also be connected directly to one pair of mains for direct generation during the heaviest loads. (This provides merely for charging the batteries alike, no provision being apparently made in case the two sets of batteries have been discharged unequally.) In case an equalizing machine is used for regulating the voltage during the charge, it is recommended to have the auxiliary charging machine coupled directly with the equalizing machine so that the latter will also serve as a motor for the former.

Lamps in England.—The Lond. "Elec.," Dec. 4, gives some interesting graphical statistics of the lamps connected or "lampages" in London and in the United Kingdom; the present totals for London are 925,000 and for the Provinces 670,000; in both London and the Provinces these are divided almost equally between the alternating and the direct current systems, being still slightly in favor of the latter; in the Provinces, the number of lamps is about equally divided between stations operated by municipalities and those operated by private companies, but in London the difference is very largely in favor of the companies.

Central Stations in the United Kingdom.—The Lond. "Elec.," Jan. 4, publishes as a supplement a large table containing a list of the stations in London and the Provinces with a considerable amount of tabular data for each; it includes also a table of those under construction and a map showing the locations; this is doubtless the best table of the kind which has been published.

Water Power Installation.—A small water power plant in France is described in detail with illustrations in "L'Elec.," Jan. 5.

Fecamp.—The description of this station is concluded in "L'Elec.," Dec. 29.

Statistics of Electric Fires.—The "West. El.," Jan. 19, contains a summary of the causes of electric fires by Mr. Merrill, the expert of the Underwriters' Electrical Bureau of Chicago, during the year ending Oct. 1, 1894; the number of fires attributed to each of a list of different causes is given; the total number of electric fires which have come to his knowledge was 475, representing a total loss of nearly one and one-half million dollars; in 319 cases there was little or no loss; he admits that the data is somewhat incomplete but states that it is very instructive.

Nancy.—A translation of the description, with illustrations, mentioned in the Digest Oct. 20, is published in the "West. El." Jan. 19.

WIRES, WIRING AND CONDUITS.

Cause of Explosions in Conduits.—Mr. Enright, in the Lond. "Elec. Rev.," Dec. 28, offers an explanation of the cause of the recent Cannon street explosion. He suggests that the heat of the conductor might distill off from the insulating material an explosive gas of some sort; he found from experiment that every insulating material yielded, on heating, an explosive gas, at a temperature of 300 to 400 degrees C.; the fact was noticed at the time of this explosion, that there was no trace of coal gas nor was this gas found in the soil in the vicinity; none of the witnesses smelt coal gas, but many of them smelt india rubber and tar; furthermore, there was a dense smoke seen, which does not occur with the explosion of coal gas, but does, with the combustion of these distilled gases.

Underground Wires in Paris.—In an article by Mr. Monmerque, begun in "L'Eclarige Elec.," Dec. 15, he describes the systems which were tried and abandoned, among them being that in which bare wires were suspended on insulators in conduits.

Air Circulation in Lead Cables.—In a short article in the "Elec. Eng.," Jan. 16, it is stated that a punctured cable in Paris was repaired by passing a current of dry air through the whole cable; at the end of 41 hours the insulation was far higher than when it was laid; this process has now become part of a regular method of cable repairing and has frequently been used; it also enables a break in the lead sheath to be easily found by the whistling of the compressed air as it escapes, the cables being suspended in the sewers. The apparatus for drying the air is described and illustrated and consists of 6 cylinders containing calcined chloride of calcium; the air pressure must not be too great, that used in this case being from 14 to 42 pounds per sq. in.; paraffine cables will no longer be used in Paris, where it is proposed to use paper cables with this new system of drying; no precautions need then be made to keep out moisture in making joints.

ELECTRO-PHYSICS AND MAGNETISM.

Luminescence of Glass Due to Cathode Rays.—A paper by Mr. Burke, "On a suggestion by Prof. J. J. Thomson (see Digest, Dec. 15) in connection with the luminescence of glass due to cathode rays," is contained in the "Phil. Mag." for January. More than 100 years ago Beccaria observed that when vacuum bulbs are broken in the dark a faint glow of light was produced where the bulb lay. The present paper describes a series of researches, the object of which was to find an explanation of the phenomenon; the paper should be read in its entirety, but the following extracts will give an idea of its contents. Large incandescent lamps give a greater intensity than small ones, while very small ones produce no effect at all; by placing a plate of glass over a receiver exhausted to 20 mm, and breaking the glass a beautiful stream of white light was visible throughout the whole receiver, including a number of luminous spots; it was not possible to photograph it; the luminous spots were large when the fragments of glass were large, indicating that they had become luminous; thin, brittle plates of cast iron yielded no results; the presence of a gas is essential, although any gas sufficed to produce the effect. He investigates the three hypotheses, first, that it was due to the bombardment of the molecules of air against the glass; second, to the collision of the fragments of the glass with each other; third, an electrical phenomenon caused by the rubbing of the air against the glass. He tests each of these separately and finds that the results do not seem to harmonize with the first hypothesis; no light was produced in the absence of fragments of glass, which together with other results seem to justify the second hypothesis; no effect however could be obtained with fragments of cast iron, ebonite, sealing wax, bone, etc. The experiments do not seem to throw much light on the Crookes theory of luminescence due to the emitted particles of gas. Experiments to investigate the third hypothesis led to no interesting results.

The Future of Electricity.—An article on this subject by Mr. Walker is contained in the Lond. "Elec. Eng.," Jan. 4; he discusses the possibilities of the (somewhat remote) future, laying stress on the energy of wind, water and the sun's rays, and its possible utilization.

Alternating Current Condensers and Dielectric Hysteresis.—A paper by Messrs. Bedell, Ballantyne and Williamson read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted in their Proceedings (recently published). They describe investigations undertaken to determine the behavior of condensers when used on alternating current circuits, particular attention being given to hysteresis in the dielectric. The paper was printed in full in the "Phys. Rev.," vol. 1, No. 2, 1893.

Irregularities in Alternating Current Curves.—A paper by Messrs. Bedell, Miller and Wagner read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted in their Proceedings (recently issued). They show that instantaneous curves have marked irregularities so that one period should

not be taken as typical. The whole paper was printed in full in the "Phys. Rev.," vol. 1, No. 3, 1893.

The Electric Strength of Solid, Liquid and Gaseous Dielectrics.—A paper by Prof. Macfarlane and Mr. Pierce read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted very briefly in their Proceedings (recently issued). It contains an account of measurements made with paraffined paper, beeswaxed paper and kerosene oil, also a discussion of these results together with those previously obtained by Macfarlane and Steinmetz. The paper was printed in full in the "Phys. Rev." for November, 1893.

Origin of Frictional Electricity.—A translation of the article, with illustrations, which was mentioned in the Digest Dec. 2, is published in the "Elec. Age," Jan. 19.

Automatic Toepler Pump.—A paper by Prof. Morley read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted very briefly in their Proceedings (recently issued). It is operated by water pressure and has the special advantage that the mercurial pump may be placed anywhere in a building and moved about as easily as an ordinary pump while the air pressure is permanently fixed. The paper was reprinted in full in the "Am. Jour. Sci.," 1894.

ELECTRO-CHEMISTRY AND BATTERIES.

Copper-Zinc Alkali Battery.—In the "Elektrochem. Zeit." for January Mr. Oppermann, describes the following method for making a very cheap copper oxide electrode for these cells. Plates of carbon are immersed in a saturated solution made by dissolving copper scrap in nitric acid, and are afterwards dried; this is repeated until they are thoroughly saturated; after they are thoroughly dried they are heated, slowly at first and afterwards quite hot until all the copper nitrate is changed into copper oxide, care being taken that the copper oxide is not reduced to copper; this can be done without difficulty; these plates are more porous and, therefore, are very active; they may be regenerated by being washed with water and allowed to dry for several days in the air; he adds that with this the voltage is 1.2 as against 0.8.

Boron-Carbon Battery.—The "Chemical News," Jan. 4, contains an article by Mr. Warren in which he makes great claims for a battery which he has invented "capable of producing 3 volts and giving a constant current from 2 to 2.5 for almost unlimited duration." "The cells themselves are constructed upon the flat system, with sliding carbon plates enclosed in teak wood boxes, the carbons being chemically prepared by special treatment, whereby gaseous compounds of boron are so decomposed as to allow of the boron becoming absorbed into the pores of the carbon, which are afterwards soaked in a solution of oxalate of platinum, and heated to redness in an atmosphere of hydrogen. A flat porous cell encloses the zinc element while the outer cell contains a specially prepared manganic salt in admixture with each other substances." Over 2 feet of platinum wire was raised to an incandescence by 12 cells in series; for driving motors one cell "is usually sufficient."

Primary Batteries.—According to the Lond. "Elec. Rev.," Jan. 4, Prof. Jamieson in a recent interview stated that the "Walker-Wilkins non-polarizing wet battery gave a return in ampere hours of 97 per cent. efficiency of the theoretical possible output per pound of zinc in the battery," and that it would be difficult to surpass such results.

Products of Salt Electrolysis.—The Lond. "Elec. Rev.," Jan. 4, mentions some improvements regarding the method of dealing with the products, devised by a French company; the chlorine and alkali solutions being brought together outside of the apparatus, are used in the manufacture of hypochlorite of sodium, or the chlorine is used separately and the soda is mixed with litharge in a digester in which the hot solution is then carbonated, forming white lead, the liquid being further carbonated for the production of insoluble carbonate in solution of sodium chloride, the mother liquid being afterwards returned to the electrolyzer.

Plating Baths.—The paper of Dr. Krueger describing simple methods for determining the condition of electroplating baths is continued in the "Elektrochem. Zeit." for January; he discusses copper sulphate cyanide baths.

Diaphragms.—An article in the "Elek. Anz.," Jan. 3, gives a brief summary of the descriptions of diaphragms which have been proposed and patented, for various electrolytic purposes.

Manganese.—According to the "Ind. and Iron," Jan. 4, a firm in Hanover have succeeded in obtaining absolutely pure manganese in the form of a fine powder by an electrolytic separation from its compound; alkaline chlorides and chloride of manganese are employed in the crucibles.

Quantitative Analysis.—A description of a laboratory for electrolytic analysis, by Prof. Classen, is abstracted in the Lond. "Elec. Eng.," Jan. 4.

Cathodic Polarization.—A paper by Roszkowski from the "Zeit. f. Phys. Chem.," vol. 15, page 267, is abstracted at some length in the "Elektrochem. Zeit." for Jan.

Electrolytic Polarization.—A paper by Prof. Daniel read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted at some length in their Proceedings (recently issued). The abstract gives a summary of the results of experiments to study the polarization phenomena on very thin metal partitions in different electrolyte and under various conditions as to thickness of partition, current strength, temperature, etc. The paper was printed in full in the "Phys. Rev." and "Phil. Mag."

Generations of Oxygen and Hydrogen.—A paper by Prof. Nichols and Mr. Molet read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted very briefly in their Proceedings (recently issued). They describe the apparatus used at the Cornell University where the gases are stored for lecture purposes; after mentioning the difficulties in using various apparatus, he describes the present very successful form, the essential features of which are, very deep glass jars with electrodes inserted separately in long vertical tubes, the use of platinum for the oxygen side and lead for the hydrogen side.

Electro-deposition of Iridium.—A paper by Prof. Dudley at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted very briefly in their Proceedings (recently issued). A solution of sodium iridichlorid, ammonium iridichlorid, ammonium iridisulphate, were found to give good results; the bath was kept at uniform strength by using anodes of carbon surrounded by linen bags containing iridium hydrate which dissolves as fast as the acid is set free, a method which is generally applicable when the anode is insoluble.

Electroplating Hulls of Vessels.—A test of a process was recently made in Jersey City, a short description appears in the "Elec. Age," Jan. 19; the vessel was badly corroded and covered with incrustations. Tanks 5 feet square are applied to the side of the vessel, they are about 18 inches deep; the tank is first filled with strong acid for 24 hours, then with a solution of cyanide of copper for 24 hours and a current of 900 amperes at 6 volts is used, after this a solution of sulphate of copper is used with a current of 900 amperes at 3 volts for 4 days, after which the thickness of the coating is 1-16 of an inch. It is stated that the Government inspectors have expressed the opinion that the process is practicable and effective; it is stated that at present it costs the Government $100,000 for cleaning and painting the cruiser Chicago for a three years' cruise.

Electrosynthesis.—The "Amer. Chem. Jour." for December contains a long paper by Mr. Weems on "Electrosynthesis by the Direct Union of Anions and Weak Organic Acids."

Hermite System.—The conclusions of the Havre commission regarding this process are published in the "Elec. Age," Jan. 19.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Specific Heat of Water.—A Royal Society paper by Messrs. Schuster and Gannon is abstracted in the Lond. "Elec.," Jan. 4. They describe their determination of the specific heat of water in terms of the international electric units; the electrical energy was measured by measuring the voltage at the terminals and the quantity of the current by a silver voltameter, in which case it is not necessary to know the resistance of the wire nor to measure time. Their final value for J is 4.1804 Joules on the mercury thermometer scale, 4.1905 on the nitrogen scale, all at a temperature of 19.1 degrees. They refer to the recent value of Griffiths, which is exactly one-tenth of a per cent. larger. They discuss the various values of Joules equivalent; they give the equivalent in foot-pounds at Greenwich at 19.1 degrees referred to the Paris nitrogen thermometer as follows: Joule 774, Rowland 776.1, Griffiths 779.1, Schuster and Gannon 778.5. There seems to be a difference in the values obtained by the electrical and those obtained by the direct methods; whether this difference is due to some remaining error in the electrical units or to some flaw in the methods adopted by Griffiths and by themselves, remains to be decided by further investigation.

Simple Students' Apparatus.—The question whether labor saving apparatus should be used as an instrument of education, which was brought up by the recent paper of Prof. Ayrton and Mr. Haycraft (see Digest, Jan. 12) is discussed by Mr. Griffiths in Lond. "Elec.," Jan. 4. He contends that the student should at no time use an instrument until he has thoroughly mastered the principle on which its action is based; he should also be instructed how to ascertain the errors even with simple instruments like the balance.

The same subject is discussed editorially in the Lond. "Elec. Rev.," Jan. 4, the ground taken being, that the object of the experiment was to give a concrete idea of the mechanical equivalent of heat, in the simplest way and free from all elements of perplexity, and that it was not intended to be a lesson in calibration; it should be termed an experiment as it is in no sense a determination.

Quartz Fibres.—The Lond. "Elec. Rev.," Jan. 4, recommends those who intend to use such fibres to consult the very full and clear directions given by Mr. Boys in the "Proceedingsof the Phys. Soc.," Vol. 13, part 1st, page 69.

Muzzle Velocity of Shot.—A description of a method for determining

this, taken from a Cantor lecture by Prof. Lewes, is briefly described in the Lond. "Elec. Eng.," Jan. 4.

Photometry.—An abstract of a note by Mr. Ferry read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted in their Proceedings (recently issued). He gives the results of tests made to find out whether it is correct to interpose a rotating disk having sectors removed in known proportion to the area of the whole disk and then to assume that the ratio of the light which passes through to the whole light is the same as that of the open part to the whole disk. He concludes from the tests that: (1) the effects of this light upon the retina will not always be in this proportion; (2) with mixed light containing elements of different luminosities it will appear not to cut off all the elements in equal proportion but will intercept most strongly the elements of low luminosity; (3) with any given light the error introduced by the use of the disk increases as the aperture of the disk diminishes; (4) with ordinary illuminants the error is negligible when the total aperture of the disk is more than one-half of the entire disk, but rapidly increases as the aperture diminishes.

Electrostatic Volt Meter.—A simple portable form devised by Prof. Rowland is described and illustrated in the "Elec. Eng.," Jan. 16; it appears to consist simply of the usual quadrants and needle, but they are immersed in a liquid of sufficient insulation and high specific inductive capacity, such as various kinds of oils.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Long Distance Telephone.—From a brief summary, on long distance lines, published in Lond. "Engineering," Dec. 4, it appears that communications could be carried on very distinctly between Hamburg and Trieste, via Berlin and Vienna; the lines in Scandinavia opens up a theoretical possibility of connecting Northern Sweden with Southern Austria.

Grapnel.—A new form of submarine cable Grapnel, for use in recovering cables lying on rocky bottoms, is described and illustrated in the Lond. "Elec. Rev.," and Lond. "Elec.," Jan. 4.

Accumulators for Telegraphy.—In an article by Mr. Gray in the "Elec. Eng.," Jan 16, he gives a brief description of the plant of chloride accumulators installed at Albuquerque which supply the current for the circuits of the Postal Telegraph Company between Chicago and San Francisco.

Railroad Signaling.—The "Tran. Am. Soc. Civ. Eng." for Nov. contains a long paper by Mr. O'Donnell on railroad signaling with special reference to the block system; the paper seems to be limited almost entirely to the English systems; it is accompanied by a number of illustrations and by discussion of some considerable length.

Cable Signaling.—The recent paper of Mr. Delany (see Digest, Dec. 22, Jan. 5,) is reprinted in "El'ty," Jan. 16.

Transmitting, Recording and Seeing Pictures.—A selenium apparatus invented by Mr. Carey in 1877 is described and illustrated by him in the "Elec. Eng.," Jan. 16.

Peculiar Telephone Troubles.—The article by Mr. Mix abstracted in the Digest last week is reprinted in full in "El'ty," Jan. 16.

Telephone.—The one described in the Digest Dec. 8 is described and illustrated in the "Elec. Eng.," Jan. 16.

MISCELLANEOUS.

Carbons.—According to an English patent to Girard & Street the ordinary carbons for lights, batteries and electrolysis, are heated in an electric furnace to such a high heat "that they become soft and melt" the carbon being thereby transformed into graphite.

Graphite.—An academy paper of some length by Mr. Moissan is reprinted in the "L'Elec.," Jan. 5. He gives a review of a number of researches which he has made with this variety of carbon.

Electrical Events in 1894.—A list of the most important electrical events during the past year, in chronological order, is published in the Lond. "Elec.," Jan. 4.

New Product of the Electric Furnace.—The "Jour. Frank. Inst." for Jan. contains an interesting abstract from the Secretary's report. He refers in general to some of the new products and more particularly to the reproduction of calcium carbide (CaC^2) which is produced by mixing lime and carbon together and heating it in the electric arc. He attributes the discovery of this to Mr. Willson and quotes largely from an article in the "Eng. and Min. Jour.," Dec. 15. The current in the arc used was 4,000 to 5,000 amperes; arrangements have been made for the manufacture of this product on a large scale; it is stated that one short ton of the product requires 1,200 lbs. of fine coal dust, 2,000 lbs. of burnt lime and 180 electric hp per hour for 12 hours, which is not far from that required by theory; allowing $2.50 for the coal, $4 for the time, $6 for the energy and $2.50 for the labor, etc., makes a cost of $15 per ton; this refers to a place where there is cheap water power, coal, lime and labor; he believes that it will soon be manufactured extensively in this and other countries; the chemical combination involves heat to the amount of 61,000 units; he gives the properties of this material the chief one being that when dropped in the water it generates pure acetylene, one of the richest illuminating gases; to produce 2,000 lbs. of this gas will cost $37 on a basis of $15 per ton for the calcium carbide. He gives the properties of the gas which is much more luminous than olefiant gas; by passing electric sparks through a mixture of this gas and nitrogen, hydrocyanic acid is produced. He believes that this opens up such a scope for researches, the results of which will undoubtedly be revolutionary; one short ton of calcium carbide will produce about 10,500 cu. ft. of acetylene equal in illuminating value to 100,000 cu. ft. of city gas of 22 to 25 cp per 5 ft. burner; allowing for freight, profit, etc., such a gas could be obtained at nearly all points for 30c. per 1,000 cu. ft.; the ease with which the carbide can be shipped and the gas be prepared, should enable it to be adopted if not for the common supply of large cities, to supply the requirements of country hotels, dwelling houses and railway cars.

Carborundum.—The "Sch. of Mines Quart," for Nov. contains a short paper by Mr. Mathews on its history, physical properties and chemistry.

How Does Electricity Kill?—The "Elec. Eng.," Jan. 16, contains an article by Mr. Rosa in reply to the one by Mr. La Roche (see Digest last week.) He gives the results of 12 different measurements of the human body from hand to hand under different circumstances showing it to vary from 57,000 ohms with dry fingers grasping fine copper wires to 1,570 with wet hands grasping brass tubes or hands immersed in water containing salammoniac; with alternating currents and probably better contacts, it was 1,100 ohms, in which case 11 volts gave as strong a current as he cared to take, and that was only 0.01 ampere. He therefore cannot see how the resistance may be as low as 800 ohms with an accidental contact. Experiments with animals in which the voltage only is given are worth almost nothing and are even misleading, as it is the current that effects the body and not the voltage; he describes an experiment with a cat showing how important it is to state the current as well as the voltage. In reply to Mr. La Roche he adds that volts do not pass through anybody; also that with a long spark through the air probably only a small fraction of the total voltage is spent on the body. In high voltage discharges obtained from Leyden jars, the oscillations are separated by periods of rest, hence the maximum values of the current may be many times as great as the average; a Leyden jar discharges in so short a time that the current might be as great as 10 or even 100 amperes, and under some circumstances might flow back and forth many times before the discharge is completed. He distinguishes between two kinds of high potential discharges, those produced by Tesla with an alternator and those produced by Thomson with Leyden jar discharges; in the former case the oscillations will be even and of small amplitude, while in the second case there will be periods of rest and the amplitude will be much greater, the maximum current will, therefore, be much greater in the second case than in the first; it seems probable that the physiological effects are due to the maximum current; in either case, however, the effect is vastly less than when a Leyden jar is discharged through the body, for the current is relatively small, the larger part of the voltage being dissipated in the air.

So-called Negative Lightning.—A paper by Prof. Stevens read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted very briefly in their Proceedings (recently issued). In several lantern slides obtained by the aid of the camera, there were revealed black branches sent forth from the main lightning stem; for these he discusses two hpyotheses, that it was due to chemical reversal on the photographic plate, or that it was due to atmospheric absorption; he prefers the second.

Ozone.—A portion of the recent paper of Dr. Froelich abstracted in the Digest Nov. 17 is reprinted in "El'ty.," Jan 16.

New Books.

THE ELEMENTS OF PHYSICS. By Henry S. Carhart, M. A., Professor of Physics in the University of Michigan, and Horatio N. Chute, M. S., Instructor of Physics in the Ann Arbor High School. Boston: Allyn and Bacon. 382 pages, 298 illustrations. Price, $1.50

This is a book for the class-room as distinguished from a manual for the laboratory. The experiments are mostly qualitative to illustrate principles. The sequence of topics is such that the pupil may pass from subject to subject with the aid of what he has already acquired. It is claimed with justice that every experiment, definition, and statement of principle is the result of practical experience in teaching classes of various grades. As a result we have a clearly formulated statement of facts such as every student should be thoroughly acquainted with before he sets out to explore for himself. If all were teachers like these, we should have no more of the silly method of putting to work an ignorant student to re-discover the laws of physics without benefit from the experience of others. The get-up of the book is in keeping with its other claims for clearness. At the head of a paragraph the subject is given in full-faced type. Laws are given in italics, as well as words and terms defined. Directions for experiments are put in type a size smaller than the context. The reviewer can unhesitatingly commend this book to teacher and pupil.

Telephone Patents.

The counsel of the Harrison International Telephone Company has addressed a letter to the Central Union Telephone Company, Chicago, in regard to a circular issued by the latter, giving notice that "the American Bell Telephone Company owns Letters Patent No. 463,569, granted to Emile Berliner, Nov. 17th, 1891, for a combined telegraph and telephone, and controls Letters Patent No. 474,231, granted to Thomas A. Edison, May 3d, 1892, for a speaking telegraph, which patents cover fundamental inventions and embrace *all forms* of microphone transmitters and of carbon telephones," and which rights the Central Company controls in its territory.

"The reception of these circulars and alleged infringement notices are a constant annoyance, damage and injury to our clients, their customers and their business affairs," says the counsel of the Harrison Company. "These notices cannot be intended for any other purpose or effect than a threat of intimidation to the parties to whom they are sent, and an attempt upon your part to scare out and drive away buyers and users, present and prospective, of our client's telephones, and to harass and embarrass their business arrangements in all parts of the country, present, contemplated and prospective. We are well aware that the equity courts of this country are powerless to prevent these vicious and unwarranted proceedings upon your part, but we are aware, also, that both the civil and criminal courts of this country are open to our clients, upon their part, to stop this performance. Neither the American Bell Telephone Company, your company, or any other company, corporation or individual has any patents upon 'fundamental inventions that embrace all forms of microphone transmitters and of carbon telephone.' The Patent Office of this country issues no such patents and you certainly have none, or the protection of any such patents, and the American Bell Telephone Company owns no such letters patent, nor do you own or act under any such patents. One of the letters patent, viz.: The Emile Berliner patent of Nov. 17th, 1891, made prominent in your circular as one of these patents, has just been branded by a high federal court of this country as a fraud, and its judicial extinction ordered. No suit has ever been brought by the American Bell Telephone Company or yourselves, jointly or severally, under either of the patents identified in your notice, nor will ever be brought against our clients or any of their patrons. We have simply to state to you that upon any further action upon your part, in sending out these notices to our clients, or their patrons, you will be held personally responsible in every form of action civil or criminal, known to the law for such procedures, and we have been thus definite with you as to this matter so that hereafter there can be no mistake as to your position or ours."

Telephone Switchboard.

We illustrate herewith a diagram of the switchboard system of the National Telephone Manufacturing Company, of 620 Atlantic avenue, Boston, Mass. This system has been the subject of much thought and it is claimed that in no particular does it infringe any of the numerous switchboard patents of the American Bell Telephone Company. To illustrate the operation of the switchboard, we will suppose that station No. 50 desires to talk with station No. 75; placing the receiver to his ear the former presses the bell box button or depresses key *R* and calls into the transmitter. This connects him with the exchange, and he asks the

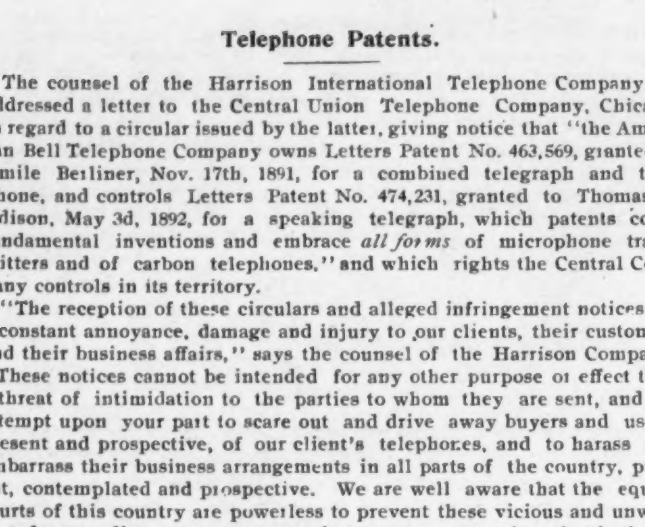


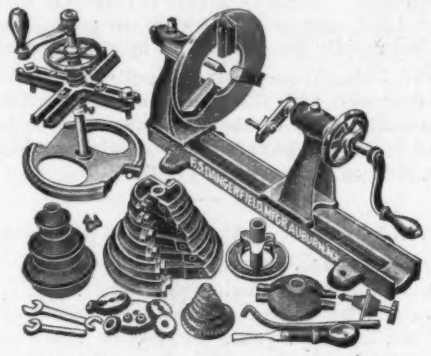
Diagram of Telephone Switchboard.

operator to connect "75 on 50", then releasing the button or key. The operator then makes the desired connection at the switchboard, and the subscriber replaces his receiver in the holder and rings up 75; the operator may do the ringing up, but it is thought more desirable, in order to save the operator's time, to have the subscriber attend to this. A relay or night alarm is attached to the switchboard, which enables the operator's services to be dispensed with, as the alarm will call a clerk to the board to make the desired connections, and afterwards the subscriber can do his own ringing.

Switchboards of this system for twenty-five to fifty stations can be placed in country stores or post-offices where clerks are in constant attendance. They take up very little room, the dimensions of a board for from 25 to 200 stations being not over five feet high, three feet wide and two feet in depth. Boards for 200 subscribers and upwards are made in the form of tables, with transmitters at each corner.

Valve Reseating Machinery.

We illustrate herewith a valve seating machine with its outfit of parts, manufactured by F. S. Dangerfield, Auburn, N. Y. These machines are designed to repair steam, water, oil and ammonia valves, both flat and taper or conically-seated, and without disconnecting the valve shells from the pipes. By this process it is claimed that valves may be renewed 10 or 15 times and with very little time required at each removal. The machine illustrated has an extension frame for an entire length of valve stem and the various parts shown are adjustable cutters, blanks for

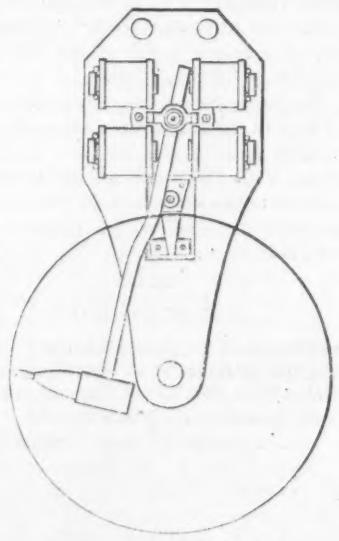


Valve Reseating Machine and Parts.

the inside of valve discs, a device for cutting flat or taper seats without disconnecting the valve shells, taper guides of various sizes, a guide for ammonia valves, a dog for check valves, extra spindles, collars, etc. The size of the machine illustrated will reseat 15 different sizes of valves from ¼ to 8 inches.

A New Electric Bell.

No kind of simple electrical apparatus is more generally known or made than electric bells, and it would seem that all possible changes had been rung in the various forms given to this staple article. Recently, however, a new form has been introduced by J. H. Bunnell & Company,



New Vibrating Gong.

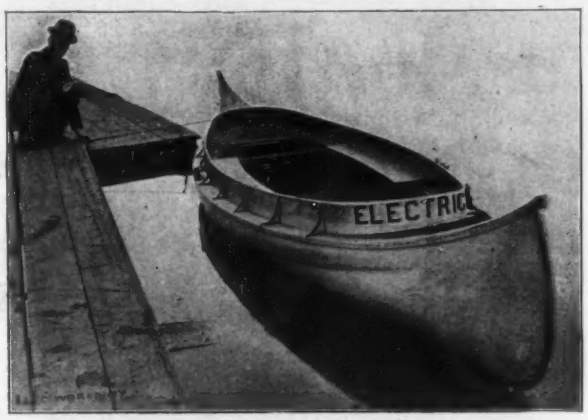
76 Cortlandt street, which is claimed to mark a distinct advance in this line of electrical appliances.

The action of this bell differs from that of other forms, in being independent of springs. The hammer is withdrawn after its forward stroke, by the attraction of an extra pair of magnets, thus placing it in position to give a strong rebound to start and assist the forward stroke, which is then made with the added attraction of a separate pair of magnets.

The hammer moves twice as far, and is about three times as heavy as in old forms. It does not have to overcome the force of any spring in its forward stroke, but is helped instead by a powerful recoil from the backward movement. The result claimed is that, with an equal amount of battery power, the blow delivered on the gong is fully trebled as compared with the old method. The illustration gives a view of the mechanism of the new bell.

A Small Electric Launch.

The electric launch illustrated herewith is owned by Mr. W. H. Chapman, of Oldtown, Me., and has been in successful operation during the past season. The length over all is 21 feet 6 inches, the width—sponson included—4 feet; the width inside is 3 feet, and the depth, 14 inches. The launch or canoe is made of canvas and lined inside with cedar. It carries fourteen cells of chloride storage battery of 150 ampere hours capacity. The motor is of the multipolar type, geared down four to one, and runs

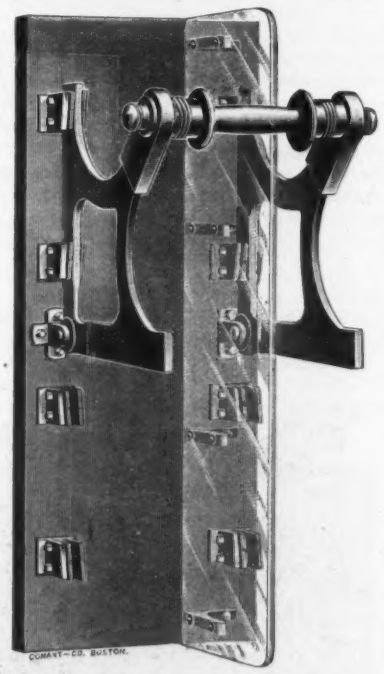


SMALL ELECTRIC LAUNCH.

without noise. With four persons, a speed averaging eight miles per hour for ten hours has been made. The operator has full control of the craft from the bow. The rudder is connected with a small flexible shaft worked by a steering wheel in the bow.

A New High Potential Switch.

We illustrate a new type of high potential knife switch designed by Mr. Charles H. Herrick, and manufactured by the W. S. Hill Electric Company, 133 Oliver street, Boston, Mass. The engraving shows one



HIGH POTENTIAL SWITCH.

of a group of six switches now in use by the Narragansett Electric Lighting Company, of Providence, R. I., where they are successfully carrying alternating currents of 400 amperes and 1,000 volts. The switch has a very quick break, with a flash guard between its opposite poles; it breaks both machines and circuit, and has its yoke at a point of absolute safety, both to operator and switch. In operation there is no flash when the switch is thrown, and only the slightest possible "wink" in the lamps to which it supplies current.

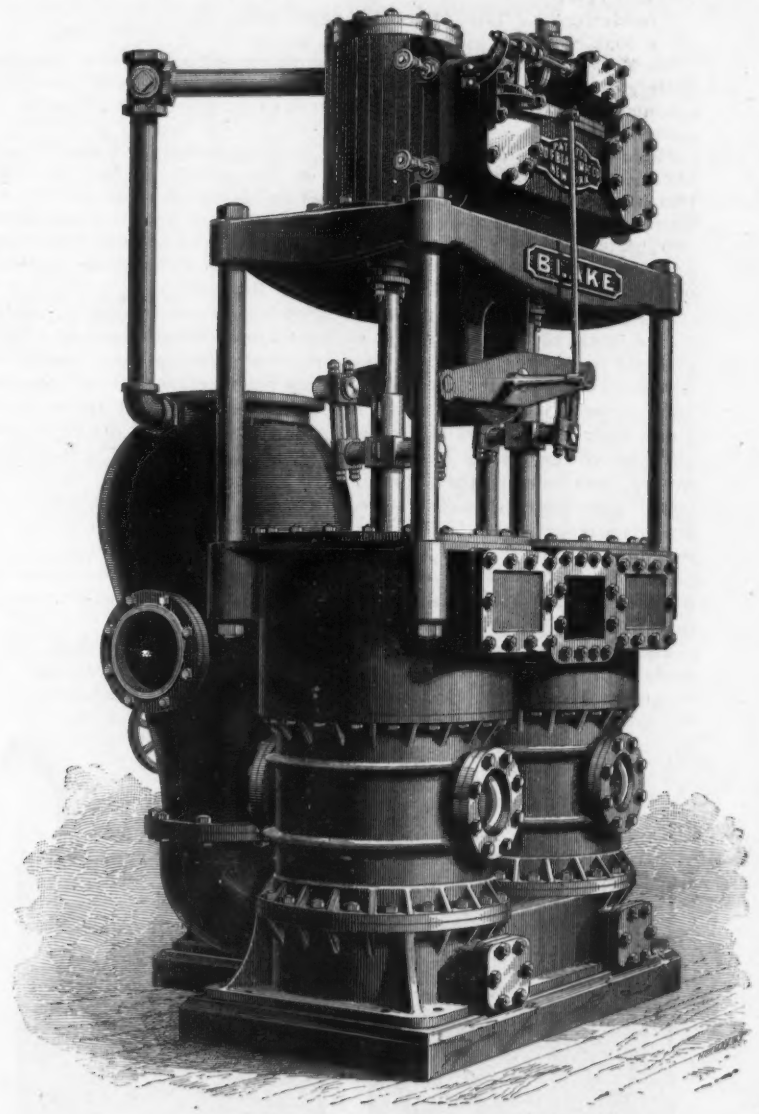
The switch shown is adapted for use on the front of switchboards, but designs have been completed for the same type of switch to be placed on the rear of the board. This latter type is operated by a lever and handle extending through a slot cut in the switchboard. The switch has solid cast copper blades, micanite insulation on the yoke, and the Hill reinforced contacts, and will be given a carrying capacity of 50 per cent. in excess of its regular duty to allow for all reasonable overloads. It is adapted for all varieties of duty from 110 and 500 volt circuits, to alternating circuits of 2,000 volts and over.

It is the intention of the manufacturers to build these switches, to which the name of "the Herrick High Potential Switch" has been given, in all sizes and types as demand may arise for them, and to perform any special duty.

The alternating switchboard designed by Mr. Herrick for the Narragansett Electric Lighting Company, on which the switch is shown, is capable of handling 50,000 to 100,000 16-cp lamps. The board is of Italian marble, 28 feet long and 6 feet high, and is so designed that all changes of machines and circuits may be made instantly and without the use of plugs or cables of any sort, and to admit of the generators being arranged to run in multiple or independently as desired.

Vertical Twin Air Pump and Jet Condenser.

The accompanying illustration shows the well-known Blake vertical twin air pump of the Geo. F. Blake Manufacturing Company, 95 Liberty street, New York, with the addition of an automatic jet condenser. This air pump, in connection with a surface condenser, is similar to those that have been so successfully applied to all the later large United States naval vessels, like the "New York," "Columbia," "Minneapolis," "Indiana," "Massachusetts" and others. The power necessary to run the pumps as taken from the official tests was only about one-fourth of one per cent. of the total power of the main engine, while in the case of the last vessel tried, the "Minneapolis," this power ran as low as one-sixth of one per cent.



AIR PUMP AND JET CONDENSER.

Owing to this remarkable success the Blake Company was induced to apply its air pumps to stationary engines, and for this purpose attached to them its automatic jet condenser. This form has now been adopted by many large electric light and power plants in San Francisco, Chicago, St. Louis, Cincinnati, Baltimore, Philadelphia and Boston. Not only is this arrangement adapted to stationary engines, but the application to marine engines, especially for fresh water service, is very desirable, as compactness, minimum weight and efficiency are all indispensable qualities for this class of service.

The composition lined air cylinders are furnished with single acting buckets containing small disc valves. The foot valves are similar to these and are placed in the lower suction base of the pump. The pis-

tons of the steam cylinders are connected rigidly to the air buckets through the medium of the bucket rod and piston rod, which are both securely keyed in a common crosshead. The two crossheads are attached to the working beam by means of two pairs of links, thus making the two sides of the pump act together and producing a very steady and uniform motion. The steam pistons are controlled by ordinary "D" slide valves connected together by levers and links, receiving their motion from an auxiliary piston which works in a horizontal cylinder shown in front of the main steam chest. The steam to work this auxiliary piston is distributed by a small auxiliary slide valve also of the ordinary "D" shape, which is attached to the exposed valve stem. The latter has two small adjustable collars engaging with one lever of a bell crank, which receives its motion from a connection attached to the working beam. By adjusting these collars on the auxiliary valve stem, the pump can be made to run short or long stroke at will with no possibility of stoppage, however slow it may be running.

The steam consumption can also be reduced to a minimum by utilizing the heat of the exhaust steam from the pump cylinders in raising the temperature of the feed water, or passing the exhaust into a receiver of the main engine if of the compound or triple expansion type.

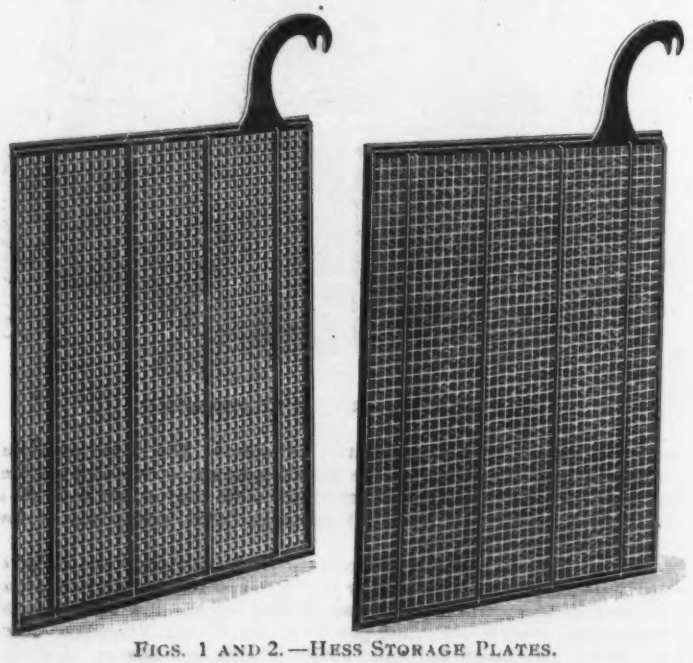
The Hess Storage Battery.

The storage battery we illustrate, manufactured by the Hess Storage Battery Company, 246 Arch street, Philadelphia, is claimed to differ fundamentally from other storage batteries through the employment of a double electrode.

The active material in this battery is not pasted upon a single lead plate, exposed directly to the action of the elecrolyte, but the lead plates are in pairs, forming what is termed a double electrode or conducting body for the active material, which is interposed between the two plates. These plates are perforated, as shown in Fig. 1, and are entirely covered with an insulating material, excepting those portions of the inner faces of the plate indicated by the light lines in Fig. 2.

The perforations of the plates are filled with a non-conducting material of great porosity, composed of quartz sand, the particles of which are held together by asphalt. These plates are used in pairs—two being necessary to form one electrode. They are put together with the exposed lead surfaces facing each other, and are so arranged that the exposed lines, both vertical and horizontal, of one plate are not directly opposite the corresponding lines on the other plate, but half a space removed, thus reducing the dimensions of the squares formed by the exposed lines one-half and doubling the amount of conducting surface. By this arrangement it is claimed that no more metal is required for a double electrode than is customarily used in the accumulator type of pasted grid. The plates are provided with projecting ribs, shown in Figs. 1 and 2, which form a space for the introduction of the active material.

The electrodes are assembled in the usual manner, the double electrode with its two plates representing one element. The insulators or separators between the electrodes are hard rubber strips, with buttons at



Figs. 1 and 2.—Hess Storage Plates.

intervals of two inches. The object of using separators of this peculiar construction is to allow a free circulation of the electrolyte from all parts of the cell between the plates. The electrodes are held together as indicated in Fig. 4, soft rubber washers being used to allow for expansion.

After the assembling of the electrodes they are placed in a cell, which is constructed of wood and lined with thin sheet lead. The electrolyte is then introduced, completely immersing the electrodes, and then the plates are ready for receiving the active material.

In the application of the active material an appliance called a conveyer is used, as shown in Fig. 3. The illustration shows the conveyer applied to a single cell, but in setting up a battery installation the material is applied to the entire set of cells by the operation of a continuous conveyer. This conveyer forces the active material into tubes

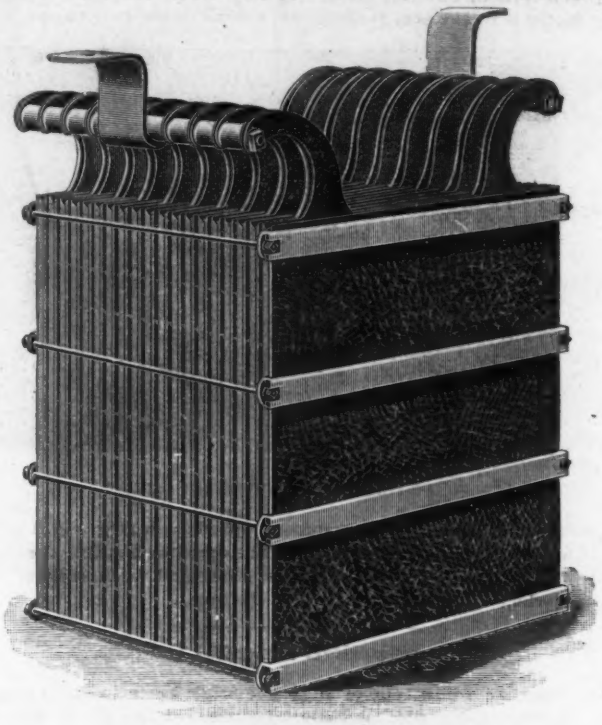


Fig. 4.—Completed Cell.

or conductors, which register with the spaces between the two plates of each electrode; from these conductors the active material falls between the plates, until the space is filled, thus being brought into contact with the exposed conducting surfaces of the plates shown by the lines in Fig. 2, and the cell is now ready for the charging current. Fig. 3 is made from a photograph of a completed cell whose dimensions are 19x21x24 inches, composed of nineteen electrodes 18x20 inches, with conveyer for the introduction of the active material.

The manufacturers claim that the Hess storage battery is the only one in which there are no exposed metallic surfaces, in which the conducting plates are protected from consumption, and that has a protection to prevent disintegration and falling of the active material, without the necessity of filling up the spaces between the electrodes. Other claims are that it is the only storage battery to which the active material is fed after the plates are immersed in the battery fluid, and in which the perforations of the conducting plates are filled with a non-electric conducting porous material.

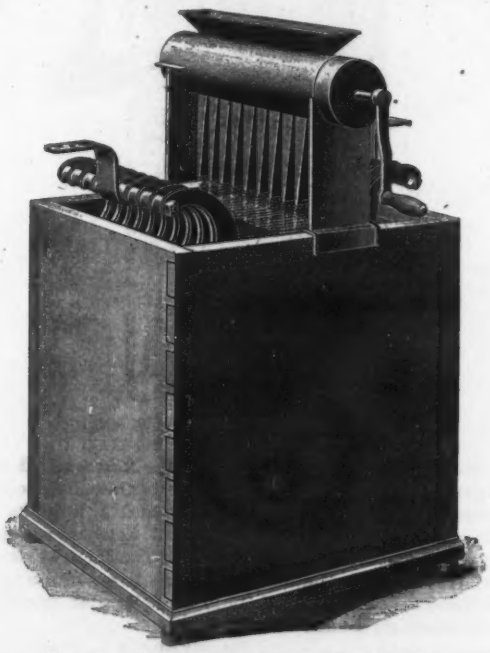


Fig. 3.—Applying Active Material.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan. 19, 1895.

GENERAL ELECTRIC, ordinarily, could be depended upon to make itself conspicuous in any such upward movement as has been recorded this week, but several things have conspired to hold the stock in check. For one thing, it is freely prophesied that decisions close at hand in several current matters of litigation will be adverse to the General Electric Company. It is expected that the court will rule against the company in the finding on the Bate refrigerator case. It is also reported that the decision expected shortly in the suit over the filament used in electric lights will be adverse. Just how these reports can be substantiated ere the decisions are made public, is hard to tell, but they have carried weight enough to induce some heavy selling of the stock, the Equitable Life Insurance being prominent among those holders that have been induced by the week's attacks to let go their stock. Then, again, there are the most positive assertions that the $1,000,000 debentures purchased by the company were not bought with cash from surplus earnings, but with the proceeds of the sale of treasury assets. The company's officials hold that its policy, financial and otherwise, has been conducted on a businesslike basis, and that there is nothing reprehensible in the conduct of the company in any respect or quarter. They assert that the company is doing a large and increasing business. There are now employed at the Schenectady works of the General Electric Company about 3,200 hands, and at Lynn about 1,600 hands, as compared with a regular working force ayear ago of 1,300 at Schenectady, and 800 at Lynn. It is freely admitted that treasury assets are sold whenever a good chance presents itself, as, for instance, when the company sold this week, to Messrs. Tucker, Anthony & Co., of Boston, the Macon Consolidated Street Railway Company, with $300,000 bonds, and $500,000 stock. The price is not given, but it is stated that the General Electric Company did not get the short end of the transaction. Sales of this kind will be made whenever possible, as it is the intention of the company to confine itself to its own business of manufacture, and have as little as possible to do with subordinate companies or their operation.

EDISON ELECTRIC ILLUMINATING (New York) stock is very strong on the excellent showing made during the past year. Treasurer Jos. Williams furnishes THE ELECTRICAL WORLD with the following figures of receipts and expenditures, and a goodly showing they make, indeed. Gross earnings for the month of December, 1894, were $165,994, an increase of $22,802, and net earnings amounted to $81,358, a gain of $6,390 over December, 1893. The results for the year ending December 31, 1894, are: Station earnings $1,369,066, an increase of $175,727; operating expenses, $550,426; net earnings of stations, $818,639; earnings from other, $32,944, and income derived from investments, $62,325, as compared with outside income in 1893 of $52,186; total net receipts $913,909; general expenses and taxes $124,443; net earnings of company, $789,466, a gain of $183,828 over the previous year's showing; royalties accruing previous to 1894, $46,000; total applicable to interest and dividends $835,466. Interest payments called for $207,266, and dividends required the distribution of $476,196, so that there is left as a result of the year's operations the tidy surplus of $152,004. The number of customers on the first of January was 5,837; number of lamps 16 candle power, 234,494; motors (horse-power) 7,616; arc lamps, 3,014; installations equal to 340,784 lamps of 16 candle power. The stockholders showed their appreciation of the management's efforts by re-electing the old Board of Directors, except that Mr. Arthur C. James, of Phelps, Dodge & Co., bankers, was selected to fill the vacancy caused by the death of Mr. J. Hood Wright, head of the old firm o Drexel, Morgan & Co., and Mr. G. F. Gregory, of the Standard Oil Company, replaces Mr. E. H. Johnson. Other members of the directory are: A. A. H. Boissevain, R. R. Bowker, C. H. Coster, Charles E. Crowell, Thomas A. Edison, W. R. Glyn, D. O. Mills, Geo. Foster Peabody, W. A. Read, F. S. Smithers, and Spencer Trask.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES' trustees have again purchased and cancelled 939 shares of the preferred stock, paying therefor an average price of 110½, the highest yet paid, and way in advance of what was paid for the first lot, which were bought under 90. The present purchase makes a total of 23,500 shares purchased to date, and leaves outstanding but 21,500 shares. Within a few days a semi-annual dividend of 3 per cent. will be declared on the preferred stock, payable February 1. The dividend on the outstanding stock calls for but $64,500, and the company has the money in bank. Under the circumstances there is a great demand for the common stock, but it is very closely held, and rules very strong.

WESTERN UNION TELEGRAPH is awakening to new life, but no great speculative, such as marked the old time course of the stock under the late Jay Gould's skilful manipulation, is likely to occur. The floating supply of stock is as small as ever, and with the continuation of the investment demand for the stock, it is destined to lose its once notorious reputation as a stock exchange football.

AMERICAN BELL TELEPHONE still sags; the cloud thrown on it by the stock subscription fiasco still casts a depressing shadow on quotations. Added to its other current foes, there are revived reports of coming competition, and some basis is formed for them in the incorporation at Chicago of the Cushman United Telephone Company, capital $20,000,000, to manufacture telephone supplies, and to construct and operate telephone and telegraph exchanges. Nonetheless, the Bell Telephone Company is to-day a paying institution, and its profit making opportunities are not in any immediate danger of curtailment. Accordingly, there is not much likelihood of the stock selling much under current prices, unless some unexpectedly adverse blow be received from what is at this writing an unknown and improbable quarter.

WESTINGHOUSE ELECTRIC issues are very quiet; speculation in them seems for the moment to have entirely died out. The removal to the new Brinton shops is steadily progressing; it will be sometime, however, ere everything is in apple pie order.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	128	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
*Edison Electric Ill., New York	100	101	102
* " " " Brooklyn	100	110	112
" " " Boston	100	122	124
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	35	40
Electric Construction & Supply Co., com.	15	7⅛	10
" " " " pref.	15	7⅛	10
Fort Wayne Electric	100	1½	2
General Electric	100	34	34¼
General Electric, pref	100	67	70
Westinghouse Consolidated, com.	50	32½	33
* " " pref	50	49½	50

BONDS.

Edison Electric Ill., New York	1,000	108	109
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	92½	93

TELEGRAPH AND TELEPHONE.

*American Bell Telephone	100	190	191
American District Telegraph	100	35	40
American Telegraph & Cable	100	92	93
Central & South American Telegraph	100	102	105
Commercial Cables	100	138	145
Erie Telephone	100	52½	53
Gold & Stock Telegraph	100	103	105
*Mexican Telegraph	100	180	190
Mexican Telephone	100	75	80
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97	98
Postal Telegraph-Cable	100	50	55
Western Union Telegraph	100	88	88¼

*Ex div.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	120	130
Brooklyn Traction, pref	60	63
" " com	12½	13
Long Island Traction	11	13
Rochester St. Ry	36	38
Columbus St. Ry	45	50
Louisville St. Ry. pref	87	88
" " " com	37	39
Cleveland Electric Ry.	59	60
Cleveland City Ry.	68	70
North Shore Traction	23	25
New Orleans Traction	58	60
New Orleans Traction pref	58	60
Worcester Traction pref.	80¾	82
" " com.	12½	14
Metropolitan Traction, Philadelphia	101½	102
Philadelphia Traction	95	96
People's Traction	51	52
Binghamton R. R. common	100	—

BONDS.

	Bid.	Asked
*Union Ry. 1st. mtge 6s	105	108
*Westchester Electric 1st. mtge. 5s	98	101
Rochester St. Ry. 1st. 5s	95	97
*Columbus St. Ry. 1st 5s	95	97
Columbus Crosstown 1st. 5s	95	97
*Binghamton Railroad Co. 5s	99	100

*With accrued interest.

ELECTRIC TRACTION STOCKS have been unusually prominent this week. Here in New York interest has been chiefly centered in Brooklyn Traction and Long Island Traction, both of which are lower by reason of the serious strike now in progress on their lines. New Orleans Traction, another security, dealt in here, is higher, however; large local banking houses interested in it have within recent days asserted themselves to the extent of assuming the entire management, and much promise of future prosperity is held out thereby. In Boston there has been a deal of buying of West End common, and the belief still holds good that New York interests are in a deal to secure control. New England Street Railway stock is lower on the agitation started in New Haven to tax Connecticut street railways 3½ per cent. of gross earnings, to keep in repair streets and sidewalks. In Philadelphia selling of the traction stocks

continues, to the detriment of prices. Philadelphia traction being the chief subject of liquidation. It is stated that the local politicians are unloading in anticipation of a legislative inquiry into their dealings with the traction companies. Another item of interest is to the effect that the stocks of two more railroads can soon be treated of as electric tractions; these stocks are Kings County Elevated, of Brooklyn, and North Chicago Street Railway. The Brooklyn road has decided to operate by trolley, and is only awaiting the submittal of satisfactory plans. Concerning North Chicago, President Charles T. Yerkes has this to say: "By July 1 three-fourths of the horse lines will be run by electricity. Formerly a set of motors cost $2,500, and their life was short. Now they cost but $800. What is more, we now can get 90 per cent. of the steam power in electric form instead of 60 per cent. and the cost of machinery connected with the power plant has been reduced over one-half. Wherever you have electric cars, travel will increase fully 30 per cent." And this is from an experienced street railway man. The earnings of the Binghamton Railroad Company, reported in the last issue of THE ELECTRIAL WORLD, were for the last six months of 1894, instead of for the year as stated. They are as follows: gross, $70,913; increase $13,258. Net $32,958; increase $8 131. Operating expenses were decreased 3¼ per cent.

Special Correspondence.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, January 18, 1895.

THE BROOKLINE GAS LIGHT COMPANY, of Boston, has been granted by the Massachusetts Gas and Electric Light commissioners the $1,000,000 increase of capital stock petitioned for, upon which numerous public hearings have been given, and in connection with which the company's books were subjected to an examination by the commissioners, which occupied three weeks. The vote of the corporation declares that the new stock will be used in increasing the plant of the company, and paying off its debts.

MR. FRANK X. CICOTT, manager of the railway department of the Pettingell-Andrews Company Boston, has returned from his European trip, looking the picture of health and happiness. He says that he had altogether an enjoyable trip, and reports the electrical business in Europe, in all branches, as improving, particularly in France, Germany, Russia and Belgium, where the electric railway is receiving rapid recognition, the trolley becoming more popular, and American electrical appliances, generally, in better demand.

MURDOCK & TABER, a new electrical firm, with headquarters at 185 Franklin street, Boston, commence business under very favorable auspices, and with the best wishes of hosts of friends. They propose making a specialty of manufacturing and dealings in telephones and telephone supplies, and their long experience in telephone work should enable them to present efficient and creditable productions. They are now offering to the trade, of their own manufacture, a new adjustable watch receiver, and also a new automatic switch for telephones, both of which possess excellent advantages. The manufacture of dies, moulds and experimental work will also be a feature of their business.

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, Jan. 5, 1895.

TRANSFORMER PITS.—As I stated in a recent letter, the Board of Trade was appealed to with reference to a dispute between the County of London & Brush Provincial Electric Lighting Co. on the one hand, and the London County Council on the other, with reference to the construction of transformer pits under the pavements and roadways. The County Council alleged that such structures would be a public danger, a public nuisance, and were not necessary to the carrying on of the company's business. The case was argued before the Board of Trade on Thursday, Dec. 13 and 20, and at the conclusion the permanent secretary of the Board of Trade, Sir Courtenay Boyle, gave his decision, or to be absolutely accurate, stated the "nature of the advice that he proposed to give to the Board of Trade." Briefly put, the Board of Trade will not veto the principle; but, as regards the construction of particular transformer pits, the Board of Trade will take care that all due regard is paid to the public safety, the public convenience, and the rights of local authorities. This, I think, must be considered as a "famous victory" for the company. No doubt the system of transformer pits placed under the pavement enables a supply company to indefinitely multiply its feeding points, and in this way tends to produce a very uniform pressure throughout its entire network, and it tends also to minimize the chance of a big break down. At the same time, there can equally be no doubt that the main advantage of the system is its cheapness. In connection with this subject, it is of interest to note that the Board of Trade have already issued regulations with regard to transformer pits in several instances; the following is a sample: No single transformer pit is to contain a transformer of higher hp than 100; the entrance to the chamber is to be only large enough to admit the entrance of a man; the covers are to be metallically connected on either side to the sheathing of the mains; beneath the first cover, there is to be a second metal cover independently supported and free from metallic connection with the external cover, and effectually connected to earth.

General News.

NEW INCORPORATIONS.

THE AMERICAN TELEPHONE COMPANY, Johnstown, Pa., has been formed with a capital stock of $15,000.

THE WATSEKA AUTOMATIC TELEPHONE COMPANY, Chicago, Ill., capital stock $10,000, has been incorporated by W. H. Harry, H. Darlington and R. E. Wood.

THE LASALLE CONSTRUCTION COMPANY, Chicago, Ill., capital stock $100,000, has been incorporated by W. E. McClurg, C. H. Bumstead and F. S. Donnell.

THE ATHENS ELECTRIC RAILWAY COMPANY, Athens, Ga., capital stock $50,000, has been incorporated by W. S. Holman and others to construct an electrical street railway.

THE TRI-VILLAGE TELEPHONE COMPANY, Fort Edwards, N. Y., capital stock $2,500, has been incorporated to connect Fort Edward, Sandy Hill, Glens Falls and South Glens Falls.

THE ECONOMY STREET RAILWAY COMPANY, Baden, Pa., capital stock $2,000, has been incorporated by Henry L. Carter and others, for the purpose of constructing and operating an electric railway.

THE W. J. DAVIS ELECTRIC COMPANY, Pittsfield, Mass., has been incorporated by Jacob Gimlich, Wm. P. Wood and W. J. Davis, to manufacture and install electrical and gas fixtures apparatus, etc.

THE NATIONAL GLASS COMPANY, Portland, Me., has been incorporated by L. T. Dolan and C. H. Jenkins to manufacture glass insulators and a general line of glass electrical goods. The capital stock is $250,000.

THE MILWAUKEE DYNAMO COMPANY, Milwaukee, Wis., capital stock $15,000, has been formed to do a general electrical manufacturing business. The incorporators are W. A. Ehlman, John Koerta and Theo. Egelhoff, Milwaukee.

THE NATICK GAS AND ELECTRC COMPANY, NATICK, Mass., capital stock $125,000 has been formed to generate and sell electricity for light, heat and power. Guy Wilkinson, Arthur Appleyard and Crayton N. Wilkinson are interested.

THE DRAVOSBURG AND ELIZABETH ELECTRIC STREET RAILWAY COMPANY, Dravosburg, O., capital stock $40,000, has been incorporated by H. W. Juergen, and others, for the purpose of constructing and operating an electric railway.

THE TILLAMOOK ELECTRIC RAILWAY, POWER AND LIGHT COMPANY, Tillamook, Ore., capital stock $500,000, has been formed to build, own and operate an electric railway. W. H. H. Cary, David Hess and William Squires, all of Tillamook, are interested.

THE CERAMIC CITY LIGHT COMPANY, Chicago, Ill., capital stock $50,000, has been incorporated to generate electricity for light, heat and power. The promoters are Philip M. Smith, Charles M. McKeehan, William E. Smith, Alex R. Wells and A. Curtis Vandyke.

THE WORLD'S FLASH COMPANY, Chicago, Ill., capital stock $20,000, has been formed to manufacture and sell electrical appliances of all kinds, and also electrical machinery. The interested parties are Leroy D. Thoman, Fred W. Harnwell and Walter S. Holden.

THE NUTTING ELECTRIC COMPANY, Chicago, Ill., capital stock $50,000, has been incorporated to manufacture, buy, sell and deal in merchandise and do a general contracting business. Carl K. McFadden Frank W. Smith and James W. Hedenberg are interested.

THE NANTUCKET ELECTRIC COMPANY, Nantucket, Mass., capital stock $20,000, has been formed to generate and sell electricity for light, heat, power, etc. Fred Howard Porter, John R. Bacon, W. A. Clark, Jr., George L. Smith and Henry A. Burnham are the promoters.

THE COUNTY ELECTRIC LIGHT AND POWER COMPANY, Clayton, Mo., capital stock $5,000, has been formed to generate and sell electricity for light, heat and power. M. B. Greensfelder, Central P. O.; E. W. Warfield, Clayton, and E. H. Bennett, Sutter, Mo., are interested.

THE STATEN ISLAND TERMINAL ELECTRIC RAILROAD COMPANY, New Brighton, N. Y., capital stock $50,000, has been incorporated to build an electric street surface road in Richmond County. Herman Bergholtz, DeF. Van Vlet and F. C. Cornell, Ithaca, N. Y., are interested.

THE CUSHMAN UNITED TELEPHONE COMPANY, Chicago, Ill., capital stock $20,000,000, has been incorporated to manufacture telephone appliances, and to construct and operate telephone and telegraph exchanges. I. M. Cushman, O. O. Leabhart and Joseph Barton are the promoters.

THE ELECTRIC BELL AND RESISTANCE COMPANY, Newark, N. J., capital stock $10,000, has been incorporated to manufacture and deal in electrical devices and supplies. George F. Atwood and Isaac M. Williams, both of Orange, N. J., and James P. McKenna, Newark, are the promoters.

THE AMERICAN ELECTRIC METER COMPANY, Camden, N. J., capital stock $100 000, has been incorporated to manufacture, buy and sell electric meters, electrical machinery, appliances, etc. Wm. D. Marks, Walter F. Smith and Jas. F. Gray, all of Philadelphia, Pa., are the organizers.

THE NATIONAL GLASS COMPANY, of Portland, Me., has organized for the purpose of manufacturing glass insulators and a line of glass electrical goods. The capital is $250,000, and the officers are: President, R. J. Dolan, of Boston, Mass., and Treasurer, C. H. Jenkins, of Boston, Mass.

THE PHOENIX TELEPHONE AND ELECTRIC COMPANY, Denver, Col., capital stock $750,000, has been formed to sell, deal and lease telephones, lines, systems, electric and magnetic appliances, instruments, etc. Gurnsey Walker, Preston H. Barker and Alfred W. Chamberlain, Denver, Col., are the promoters.

THE FRANKLIN TELEPHONE AND ELECTRIC COMPANY, Jersey City, N. J., capital stock $200,000, has been formed to manufacture, sell and use electrical machinery, instruments, etc. A. O. L. Havens, Point Pleasant, N. J.; John McG. Goodale and John R. MacArthur, of New York, are the interested parties.

THE DENVER HEAT AND LIGHT COMPANY, Denver, Col., capital stock $1,000,000, has been formed to operate and maintain electric generating stations, machinery and wires for transmitting electricity for furnishing light, heat and power. The promoters are John C. Feldwisch, F. Cobb and Thos. Mohr, of Denver.

THE WEST SHORE ELECTRIC LIGHT COMPANY, Fort Lee, N. J., capital stock $100,000, has been formed to construct, maintain and operate works for supplying and distributing electricity for light, heat and power. John A. Demp-

sey, Guy C. Dempsey, New York, and Leon Abbott, Jr., Hoboken, N. J., are interested.

THE KNOELLER CAR IMPROVEMENT COMPANY, Jersey City, N. J., capital stock, $5,000, has been formed to purchase patents and patent rights for improvements for use in electric and cable street cars, etc. James Riley, Patrick H. Kilroy, Daniel Y. Lewis, and Geo. B. Fielder, Jersey City, N. J., are the promoters.

THE SAN DIEGO, PACIFIC AND EASTERN RAILROAD COMPANY, San Diego, Cal., capital stock $1,000,000, has been incorporated by H. L. Storey and others to build and operate a railroad to be operated by electricity, steam or otherwise from San Diego to El Cajon, Santa Maria, San Filip, Escondido and other points.

THE GREAT NORTHERN ELECTRICAL MANUFACTURING COMPANY, St. Paul, Minn., capital stock $100,000, has been formed to manufacture and sell automatic electric annunciators, electric fire, police and burglar alarms, etc. The promoters are Henry F. Hoyt, John F. Hoyt, St. Paul, and Robert L. Hunter, Minneapolis, Minn.

THE COMBINATION POWER COMPANY OF CHICAGO, Chicago, Ill., capital stock $500,000, has been formed to acquire patents protecting power devices, to lease on royalty, or sell the right to use same on railway engines; power plants, vessels, and manufacturing power. John E. Anderson, Isaac T. Dyer and L. L. Blades are the interested parties.

THE ELYRIA, OBERLIN AND WELLINGTON ELECTRIC RAILROAD COMPANY, Elyria, O., capital stock $100,000, has been formed to construct and operate an electric railroad between the three towns mentioned; also to furnish electric light and power. A. R. Webber, W. A. Braman, R. T. Reefy, W. B. Bedortha and Chas. A. Metcalf are the promoters.

THE WHITE RIVER WATER POWER COMPANY, Newark, N. J., capital stock $1,500,000, has been formed to develop water power for commercial purposes, and to operate plants for furnishing light, heat and power. Edw. Henry Brush, 741 DeKalb avenue, Brooklyn, N. Y.; Thos. A. Quillin, 925 Garden street, Hoboken, and Thos. F. Brothers, Mt. Pleasant avenue, West Orange, N. J., are the promoters.

THE TILLAMOOK ELECTRIC RAILWAY, POWER AND LIGHTING COMPANY, Salem, Ore., capital stock $500,000, has been incorporated by W. H. Cary, David Hess and William Squires, to operate an electric railway from a point on the line of the Oregon Central Railway, in Yamhill County, at or near orth Yamhill, and follow the course of the North Yamhill, Nestucca and Tillamook rivers to a point on Netarts Bay, Tillamook County.

TELEGRAPH AND TELEPHONE.

NEVADA, MO.—W. F. Tizgard, of Rich Hill, has been granted a franchise to put in a telephone system at Nevada.

APPLETON, WIS.—The Northwestern Telephone Company of Milwaukee has petitioned for a franchise to put in a telephone exchange at Appleton.

SYRACUSE, N. Y.—The Central New York Telephone and Telegraph Company will erect a building for its exclusive use, and put the telephone wires of the city underground.

ELECTRIC LIGHT AND POWER.

PAWNEE CITY, NEB., is to build a municipal plant.

BRONXVILLE, N. Y.—Bronxville is discussing electric street lights.

GROTON, VT.—The subject of street lights for the village is being discussed.

GADSDEN, ALA.—The Queen City Electric Light Company is to enlarge its plant.

HAMILTON, MO.—The establishment of an electric light plant is contemplated.

LEWISTOWN, ILL.—The city of Lewistown will place arc lights in the streets at once.

PLATTSBURG, MO.—The citizens are discussing the building of an electric light plant.

VENICE, ILL.—An electric light plant has been established at the chain or Rock Water Works.

PHILADELPHIA, PA.—The new Belmont Avenue Baptist Church will be lighted by electricity.

ARCADIA, FLA.—F. H. Jeannin, St. Louis, Mo., is to establish an electric light plant in Arcadia.

MARTIN'S FERRY, OHIO.—A meeting was held December 29 to discuss the electric light question.

PETERSBURG, VA.—A $10,000 stock company is being organized to establish an electric light plant.

SYCAMORE ILL.—The Sycamore electric light plant will be enlarged. John W. Whalen is president.

WICHITA FALLS, TEX.—The erection of an electric light plant is contemplated. Address the Mayor.

QUINCY, MASS.—Mayor Hodges recommends the adoption of a more economical system of street lighting.

JONESBORO, ARK.—The establishment of an electric light plant is being considered. Address the Mayor.

EARLVILLE ILL.—Earlville is figuring on an electric light plant to light both stores and streets of the city.

OREGON, MO.—Address James Cummings, Mayor, concerning contemplated establishment of an electric light plant.

WHITE CASTLE, LA.—Address Mayor G. M. Bowie, regarding the erection of an electric light plant and water works.

FRANKFORT, ILL.—Porter & Covit, of Joliet, are working up matters with a view of putting in an electric light plant.

RALEIGH, N. C.—Address the mayor concerning the issuance of $25,000 worth of bonds to purchase an electric light plant.

ARCADIA, FLA.—F. H. Jeannin, of St. Louis, Mo., is said to be interested in a plan to erect an electric light plant in Arcadia.

WHITE CASTLE, LA.—The erection of electric light plant and water works is being talked of. Address G. M. Bowie, Mayor.

KANSAS CITY, KAN.—The Board of County Commissioners is contemplating lighting of the county buildings with electricity.

SANTA ROSA, CAL.—The City Clerk has been authorized to advertise for bids for street lighting for a term of three years.

CHATTANOOGA, TENN.—An electric crane will be put in the boiler works owned by Casey & Hedge Manufacturing Company.

FERGUS FALLS, MINN.—A franchise has been granted to L. Von Bornstad, and his associates, to put in an electric light pant.

BALLARD, WASH.—The Ballard Electric Light Company's plant has been purchased conditionally by the Ballard City Council.

CEDARBURG, WIS.—The Common Council of Cedarburg has granted J. W. Raeder a franchise for an electric light plant in that city.

PALESTINE, TEX.—John R. Hearne has bid in the Palestine electric light plant, and will operate it, the price paid is said to be $4,300.

NORTHPORT, L. I., N. Y.—The village of Northport is to be lighted by electricity, and the plant will be in operation by March 1st.

GRAND FORKS, N. D.—The Board of the State University have decided to put in an electric light plant. Address the President of University.

NEWCASTLE, PA.—The subject of a new electric light plant to be owned by the city will probably come up before the Council for discussion.

ARLINGTON, MASS.—A committee has been appointed to consider the matter of municipal electric lighting, and report at the March meeting.

ATHENS, GA.—Messrs. W. A. Mallory and Lamar Pyndon have leased the Athens Gas and Electric Light Works, and will improve the system.

DICKINSON, N. D.—Ed. Hughes, of Bismarck, and Senator McGillivray are completing a deal for putting in an electric light plant in Dickinson.

ANDERSON, S. C.—The Anderson Electric Light and Power Company will remove its machinery to a larger building, and increase its facilities.

BELLWOOD, PA.—It is rumored that the Bellwood Electric Light Company proposes to erect a new boiler and purchase a new engine for its plant.

NORWICH, CONN.—A petition has been presented to the incoming legislature requesting power to construct and maintain electric light and gas plants.

NORTH TONAWANDA, N. Y.—Senator Pound has introuduced a bill authorizing the establishment of an electric light system in North Tonawanda.

OWENSBORO, KY.—The City Council will make arrangements to erect a municipal electric plant.. The present franchise will be out September, 1895.

QUINCY, ILL.—The Empire Electric Light Company is seeking for a site for an electric light and power plant. W. H. Channon is a member of the company.

TAMAQUA, PA.—At a municipal election on February 15 Tamaqua will vote on the question of increasing the borough debt $15,000 for the purpose of erecting an electric light plant.

READING, MASS., has in the process of erection one of the most complete municipal lighting plants in the State. The plant will cost $50,000, and there will be 135 arc lamps, and also incandescent,

WILMINGTON, DEL.—The trustees of the Delaware State Hospital and County Almshouse have contracted with the Wilmington City Electric Company to furnish the electric light for the buildings of these institutions at the rate of 7½ mills per 16-cp-hour.

CROWLEY, LA.—Sealed proposals for the construction of the electric light plant will be received until February 4. The work comprises dynamos and installations of 22 arc lights for streets, and an incandescent commercial circuit. P. J. Chappuis is Mayor.

SIOUX FALLS, S. D.—The City Auditor has been asked for bids for the lighting of the city, either with gas or electric light. Bids to be returned to the Council at the regular February meeting. Neither the gas nor electric light plan at present has a contract.

CHADWICKS, N. Y.—It has been decided that the water power at Clayville is insufficient for the proposed electric light plant in the Sanquoit Valley, which has necessitated a change of plan. The plant will probably be located either in Chadwicks or Washington Mills.

ASBURY PARK, N. J.—Several moneyed men who have become interested in A. S. Hickley's new electric launch at Asbury Park have agreed to form a company and furnish the capital necessary for the manufacture of at least a hundred of these boats and motors.

BALTIMORE, MD.—The Great Kanawha Falls Water Power, Electrical and Land Company has been organized, and incorporation effected under the laws of West Virginia. Charles M. Reeder, of Chas. Reeder & Sons, engineers, machinists and ship-builders, 334 Hugh street, is interested.

PATERSON, N. J.—The Phillips Electric Water Company will in a short time start a dynamo and water factory in Paterson. The company has been incorporated with a capital stock of $100,000. F. H. Leonard, Paterson; Simon L. Phillips, New York, and Floyd B. Wilson, of East Orange, are interested.

WEYAUWEGA, WIS.—There is a fair prospect that an electric lighting system will be put in this village within a few weeks by the Weed & Sumner Manufacturing Company and the Badger Manufacturing Company. They have every facility for putting in a system and are now making arrangements for the work.

SAN FRANCISCO, CAL.—H. H. Taylor, of the Mills Building, is now supplying several adjoining buildings with electric lighting power from the big dynamo in the basement of the Mills Building. He plans to enlarge his system and has filed three bonds with the Supervisor for proposed laying of conduits in the centre of the city.

ATLANTA, GA.—The Machinery Committee of the Atlanta Exposition has decided to engage at once an electric and mechanical engineer, and to send a

representative North to buy equipment for the proposed electric light plant. The electric lights and operative exhibits will require 3,000 to 5,000 horse-power. J. L. Allen is chairman of committee.

MOLINE, ILL.—At the annual stockholders' meeting of the Peoples' Power Company held in Rock Island, it was decided to expend several thousand dollars in the extension of gas mains and electric circuits and to make a general cut in the rates when the consolidation of the Rock Island and Moline plants is perfected. C. H. Deere is president.

SHELBYVILLE, TENN.—The National Water Works & Construction Co., of Pittsburg, Pa. has secured the contract to erect a water plant and electric light plant at Shelbyville, Tenn. W. W. Cunningham is manager. It is the intention of the stockholders to build works all over the United States, and it is expected to have the works in question finished and in operation by July.

KINGSTON, N. Y.—Four men, whose names are withheld, and who are now engaged with one of the largest concerns for manufacturing electrical appliances in this country, desire to locate here and establish an extensive plant for making electrical appliances. They desire to organize a company with a capital of $250,000, $125,000 of which must be provided by the people.

THE PACIFIC MINERAL REDUCTION COMPANY, San Francisco, Cal., capital stock $1,000,000, has been formed to mine and mill; deal in water rights, construct ditches, electric light plants and to supply power for manufacturing purposes. The interested parties are T. J. Ryan, W. Walts, F. Milton-Johnson, G. W. Fleming and Harvey W. Snow, all of San Francisco.

WRIGHTSVILLE, PA.—Arrangements have been made by the Conewago Light & Water Power Company that will enable it to furnish Wrightsville with electric light and water, if that town wants it. The radius of country which the company proposes to reach comprises a population of nearly 400,000 people. It embraces York, Berks, Dauphin, Cumberland and Lancaster counties.

MORRISVILLE, VT.—At a village meeting it was voted to purchase the plant of the Warren & Somerville, known as the Morrisville Aqueduct Company, for $7,000. It was also voted to bond the village of Morrisville for $45,000 to cover expenses of water works and electric light plant. Hon. P. K. Gleed was elected a trustee to attend to the legal matters and H. M. Rich as agent in placing the bonds, which will bear interest at 4 per cent.

TACOMA, WASH.—It is the plan of A. J. Hayward and associates to transmit electric power into the city from a point on the Nisqually River near by. A petition was filed by the Pierce County Power and Telegraph Co., asking for the right to erect poles and string wires along the country road, extending from the city to the point on the Nisqually River where it is intended to make the improvements necessary to develop the intended power. A dam will be built across the Nisqually in order to get a fall of water to run the dynamos. A large amount of expensive machinery will be put in by the Pierce County Power and Telegraph Company. The money necessary to go right ahead with the work is said to be all ready. It is expected to have the plant ready for operation next summer. It is said that $200,000 will be spent in developing the plant.

THE ELECTRIC RAILWAY.

ITHACA, N. Y.—West Hill is to secure an extension of the trolley service.

BELLEVILLE, ONT.—Belleville is to have an electric street railway next summer.

SAYBROOK, CONN.—A project is on foot to connect Saybrook and Lynn by an electric road.

WEBB CITY, MO.—The Interurban Railway Company has begun grading its electric road from Webb City to Carthage.

PLAINFIELD, N. J.—The Common Council approved the plans for the electric railway extension to all parts of the city.

ATLANTA, GA.—Surveys are being made by the Atlanta Electric Company for the proposd extension to Lakewood, in the suburbs.

SPRINGFIELD, MASS.—The stockholders of the Springfield Street Railway Company are contemplating the extension of their lines.

MOHAWK, N. Y.—The consent of the property owners on Main street is being obtained to change the present horse railway to an electric road.

WATERTOWN, N. Y.—The Watertown Electric Railroad has decided to extend its line from Brownville to Dexter, a distance of three miles.

VENICH, ILL.—The Village Board has granted a franchise to Jenks, Meyer & Co., of St. Louis, for the construction of an electric road in this city.

ASHEVILLE, N. C.—The Asheville & Baltimore Street Railway Company has been granted a franchise to build a line two miles long to the Vanderbilt estate.

VICKSBURG, MISS.—The Interstate Transportation Company will build a trolley electric line from its gravel pits near Vicksburg to the Mississippi River.

CARLSTADT, N. J.—The borough council has determined to submit to the public the application for a right of franchise for a trolley line through Carlstadt.

MADISON, IND.—The Madison Street Railway Company's lines have recently been sold to an Eastern syndicate, the New York Standard Construction Company.

SAYVILLE, L. I., N. Y.—Sayville citizens are considering the building of a trolley road to connect Sayville with Bohemia, New Village, St. James and Port Jefferson.

ASHLAND, WIS.—The Ashland Terminal Company of Ashland, Wis., has decided to build a belt line of 18 miles around Ashtabula and will begin the work next April.

NANTASKET, MASS.—The Nantasket and Warren and Bristol branches of the New York, New Haven and Hartford Railroad are to be equipped with electricity.

LIMA, O.—The entire equipment of rolling stock of the Lima Electric Street Railway was destroyed. The car stable and eleven cars were burned up. The loss is about $30,000; only half covered by insurance.

NORWALK, CONN.—The Norwalk Tramway Company has purchased about 10 acres of land at Wilson Point road, on which it proposes to erect a power plant for its road.

ATLANTA, GA.—Dayton Hale, on behalf of the Atlanta Electric Railway Company, will apply to the City Council for a franchise to build and operate an electric street railway.

ALBANY, N. Y.—Surveyors Allen, of Altamont, and Ingraham, of Clarksville, have commenced surveying the route of the proposed electric road between Albany and Schoharie.

GRAND HAVEN, MICH.—Ald. Joseph Koeltz, of this city, will apply for a franchise to operate an electric railroad in Grand Haven. If granted, the road will be in operation by June.

COLUMBIA, PA.—It is reported that the Columbia and Donegal Electric Railway Company will extend its road from the square in Marietta to the square in Maytown, a distance of three miles.

WASHINGTON, D. C.—The contract for constructing the electric Ninth street line of the Metropolitan Railway was let to Edmund Saxton, who will quickly push the work to completion.

WARRENSBURG, MO.—It is proposed to build a motor line encircling the lake at Portie Springs before the beginning of next season. The scheme is being engineered by a local capitalist.

HULL, MASS.—The Hull Selectmen have granted the franchise asked by the Hull Electric Railway Company. The route of the new street railroad will be from Hull village to the Hingham line.

GRAND HAVEN, MICH.—At its next meeting the Council will adopt an ordinance granting privileges to a street railway company composed of local men. The road will be built to Spring Lake.

CAPAC, MICH.—The citizens of Capac are beginning to agitate the question of lighting their streets by electricity, and they desire to hear from reliable parties as to the probable cost of putting in a plant.

ASHEVILLE, N. C.—J. A. Neville, of New York, is representing Philadelphia capitalists interested in building the proposed Asheville & Baltimore electric road. J. S. Adams at Asheville may be addressed.

SHARPSBURG, PA.—At a meeting of the Councils the question of the ordinance granting the Pittsburg and Manchester Street Railway the right of way through Sharpsburg and Millvale was to have come up but was postponed.

ALEXANDRIA, IND.—Jos. E. Jeffries will build six miles of electric railway within the city limits and, in conjunction with Chas. L. Henry, a line between Anderson and Marion. Active work will be begun about April 1.

OCALA, FLA.—R. A. Teague, A. McIntyre and others have formed a syndicate to build a six mile line to Silver Springs. It is to be called the Silver Springs & Western Railway, and is to be operated by electric motors.

NEW ORLEANS, LA.—H. T. Beauregard and J. T. St. Alexander are interested in a proposed suburban road to connect with the New Orleans City & Lake Railway. The line is in St. Bernard parish. Surveys have been made.

ATLANTIC CITY, N. J.—Congressman John Gardner, ex-Postmaster Levi Albertson, Judge Joseph Thompson, and I. G. Adams & Company have applied for a franchise to construct a trolley line along the beach to various points.

LINCOLN, NEB.—The Lincoln Street Railway Company is in the hands of a receiver in default of the payment of $12,000 interest on certificates and the awarding of a judgment for $140,000 in favor of Joseph Sampson of Sioux City.

SAN FRANCISCO, CAL.—The right of way for an electric railway from Merced to the Yosemite Valley has been secured. The capital stock, it is stated, will be $2,500,000. The power is to be established at three points on the Merced River.

BALTIMORE, MD.—The Edmondson Avenue, Catonsville and Ellicott City Railway Company has purchased a lot of ground at the corner of Ingleside and Edmondson avenues from Charles Livezey, upon which will be erected a power house.

SCRANTON, PA.—At a meeting of the Select Council, Mr. Wm. Williams, of the Railway Committee, reported favorably on the ordinance granting a franchise to the Valley Passenger Street Railway Company over certain streets of the city.

YONKERS, N. Y.—The management of the Yonkers Electric Railway are contracting for a piece of land along the river front, on which they expect to erect a plant of 4,000 horse power in the spring. The manager is Jilson J. Coleman.

SEATTLE, WASH.—Contracts for the electric machinery for the Snoqualmie Falls Electric Company will be let within thirty days. D. H. Gilman has returned from the East, where he has succeeded in securing money for the erection of the plant.

AKRON, O.—A $600,000 mortgage was filed by the Akron Street Railway Company to secure the issue of 6 per cent. bonds, thus insuring the construction of electric lines from Akron to Cleveland, Akron to Kent, and Akron to Barberton, a total of 57 miles.

PORTLAND, ORE.—The Portland Consolidated Street Railway Company is in the hands of a receiver, O. P. Paxton. This company operates over 20 miles of street railways, and its property is valued at between one and a half and two millions of dollars.

MONTICELLO, N. Y.—A Mr. Van Cleft, of Newburgh, is interested in a proposed trolley line from Monticello via Fallsborough to Woodbourne and Neversink. It is said the road can be built for $6,000. Water power will be used to generate electricity.

MT. STERLING, KY.—John P. Mattin, of Xenia, Ohio, states that he will build eleven miles of standard-gauge steel track for electric motors from Mt. Sterling to Sharpsburg, Ky. Electricity will be generated by a water power and steam plant.

WASHINGTON, D. C.—A bill has been introduced in the House by Mr. English, of California, authorizing the Rock Creek Railroad Company of the District of Columbia to make some important extensions of its line, and to change the name of the company.

NEW SWEDEN, ME.—The latest proposition for giving New Sweden better transportation facilities is to build an electric railroad from there to Caribou, eight miles, and have sidings at frequent intervals. With the exception of a mile and a half the road will be level.

LEWISTON, ME.—The private electric railway which the Lewiston bleachery wants the right to build to connect the establishment with the Maine Central tracks will be of considerable importance. In 1894 it took over 3,600 freight cars to do the traffic over the Maine Central for this concern.

GREENSBURG, PA.—Application has been made for a charter by the Westmoreland & Allegheny Traction Company, which proposes at an early day to commence an electric line from Greensburg to Wilmerding, where it will connect with the Second Avenue Traction Company's road.

ELYRIA, O.—The farmers and truck raisers of Erie and Lorraine counties have organized to construct an electric railway line between this city and Milan, Erie County. The distance is about 30 miles. The following towns will be tapped by the road: South Amherst, Henrietta, Birmingham, Florence and Derlinville.

LOCKPORT, N. Y.—County Clerk Compton has received a communication from Chicago capitalists relative to building an electric railroad from here to Olcott. Mr. Compton is looking the situation over with the view of answering the queries put to him, but as yet has not quite determined as to making his response encouraging or otherwise.

MILWAUKEE, WIS.—At the meeting of the Council a petition was introduced by Alderman Starkweather from the Milwaukee and Wauwatosa Motor Railway Company, asking for a franchise to lay tracks on certain streets and to build an electric line from Wauwatosa and North Greenfield to Milwaukee to the corner of Cass and Wisconsin streets.

BARABOO, WIS.—An electric line may be built between Devil's Lake and the Dells, passing through this city. Men of money are here looking over the field, and if all arrangements can be made work will be commenced soon. A few years ago the right of way was secured, and a franchise to build through the city is now held by Marsh & Jackson, who are working on the project.

LOCKLAND, O.—At the meeting of the Lockland Council to consider the electric railway matter, an ordinance was passed establishing an electric route on certain streets, and the clerk was instructed to advertise for bids at once. This action was taken with the hope that the same parties who received the contracts to do the same work through Hartwell would be given the contract here.

BRIDGEPORT, CONN.—The Bridgeport Traction Company has applied for permission to build extensions to the West Haven and Westfied electric street railway; the Windsor Locks and Suffield Company to build to Windsor to connect with the Hartford company's tracks, and for the incorporation of the Westport and Southport road to operate in Weston, Southport and Fairfield.

READING, PA.—The Reading & Womelsdorf Railway Company gave to the Lancaster Electrical Construction Company the contract to build the road from the western bank of the Schuylkill, opposite this city, to Womelsdorf, to be completed for operation by June 1st. The road will be fifteen miles long, and negotiations are in progress to extend it to Schaefferstown, Lebanon County.

VENICE, ILL.—A franchise has been granted to the Madison, Venice & East St. Louis Railway Company, whose office is in the Bunte Building; Ferdinand Meyer is President. The construction will begin early next month, first on the Edwardsville rock road. The Venice electric light plant will temporarily furnish the power. The company's new plant will probably be located at Madison.

CENTRALIA, KAN.—The Centralia, Seneca and Pawnee Electric Railway Company has been chartered to establish and maintain an electric motor railway between the cities of Centralia and Seneca in the State of Kansas. The capital is $200,000. The directors are: A. W. Slater, J. C. Clark, S. W. Burtch, A. K. Coleman, John S. Hidden, F. A. Stickel and W. S. Domer, of Centralia, and R. M. Emery and A. Wells, of Seneca.

PORT JERVIS, N. Y.—The building of an electric railway in Port Jervis is an assured fact. A meeting of the Port Jervis Suburban Street Railway Company was recently held for the purpose of transferring the propery to its new owners. The new Board of Directors are: P. J. Horan, T. B. Howe and H. H. Archer, of Scranton, Pa.; S. A. D. Whittaker, of New York City, and Benj. Nearpass, of Port Jervis, and others. The new board elected the following officers: President, P. J. Horan, of Scranton, Pa.; Vice-President, Benj. Ryall, of Port Jervis; Secretary, H. H. Archer, of Scranton.

ANDERSON, IND.—C. L. Henry, through his agent, E. C. Carpenter, has secured a franchise for an electric street railway through Summitville, who also secured similar grants at Fortville, Pendleton and Alexandria. These franchises are for the Gas Belt Electric Railway, from Indianapolis to Marion, a distance of 80 miles. The surveys began Jan. 14, and the contract for grading the line between Anderson and Marion was let Jan. 15. The Clodfeller syndicate announces that it has also secured its right of way. C. E. Loss & Co., Pullman Building, Chicago, have a contract to complete the road before Sept. 1, 1895, for $575,000.

PITTSBURG, PA.—A company of Pittsburg capitalists has been organized to extend the electric street railway line from Washington, Pa., through the numerous towns on the Chartiers branch of the Panhandle Railroad into Pittsburg. An application has been made for a charter, and work on the line will be begun at an early date. The new company is composed of President Francis J. Torrance, Treasurer and General Manager of the Standard Manufacturing Company; Thomas R. Hutchinson, a prominent local structural iron and steel manufacturer; A. E. Townsend, President of the Washington Railway, and Senator Arthur Kennedy, a director in the Allegheny Valley Railroad and the Bellevue Land Company.

MISCELLANEOUS NOTES.

THE REV. EDWARD R. KNOWLES, LL.D., of Worcester, Mass., a priest of the Old Catholic Church, has in press a book intended to lead to an ultimate philosophy of being, and in which he considers the origin of electrical phenomena. Father Knowles claims to follow the views of Lodge regarding the non-dissipation of energy in the infinite continuance of magnetic induction between centres of force or atoms; from these considerations he deduces principles which he claims, show the absurdity of molecular motion as an essential in an electrical current, and also asserts that they indicate the true nature of electricity and lead to an ultimate philosophy of the existence of matter and of sense perception.

Trade and Industrial Notes.

THE NEW YORK STANDARD CONSTRUCTION COMPANY, 97 Nassau street, New York, has received a contract to equip the Madison, Ind., street railway for electric traction.

H. B. COHO & CO., 203 Broadway, New York, have just closed a contract for a 45-kw multipolar generator for the Cooke Engine Works, through the John E. Beggs Machinery Company.

THE STANDARD PAINT COMPANY, 2 Liberty street, New York, is sending to its friends and patrons a neat grass-woven card case, which also contains a silicate surface for memorandums.

THE WESTERN ELECTRIC COMPANY, Thames street, New York, is presenting its friends with a handsome leather card case containing a calendar of the year, neatly printed on celluloid.

THE FITCHBURG STEAM ENGINE COMPANY, Fitchburg, Mass., has recently opened an office in Boston, at 137 Purchase street, which will be in charge of Mr. W. E. Sheldon, treasurer of the company.

C. W. HENDERSON, 44 Blewry street, Montreal, has issued an "At Home" card, informing his friends and patrons that he will be glad to receive and "shock" them with electrical compliments of the season.

WALLACE & SONS, Ansonia, Conn., announce that they have now in press their 1895 catalogue of brass and copper wire and other manufactures in the same materials, and will be pleased to send a copy to all applicants in the trade.

THE LA ROCHE ELECTRICAL WORKS, of Philadelphia, has made an assignment for the benefit of its creditors to its secretary and treasurer, J. F. Stevens. The company was organized several years ago with a capital of $200,000.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has issued a third and revised edition of its pamphlet on "Graphite as a Lubricant," in which the subject is treated scientifically and practically for engineers and machinists.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has completed the new electric light station of the North Attleboro Steam and Electric Company, at Attleboro, Mass. The building is 62 ft. wide and 100 ft. long, entirely fireproof, and covered with anti-condensation corrugated iron.

THE ELECTRIC APPLIANCE COMPANY, Chicago, states that the demand for Packard transformers continues brisk, and that where it has installed the original equipment of transformers it is always sure of the orders for renewals, and has yet to record the first case where the "Packard" has been displaced.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has moved its New York office from 45 Broadway to the Manhattan Life Insurance Company's Building, 66 Broadway. The change was made to meet the increase of business of the company, and the office remains in charge of Mr. Chas. Blizard.

MAXWELL M. MAYER, manufacturer of dynamos and motors, 414 One Hundred and Seventh street, New York, although only established for a short time reports that he has already received a large number of orders for his machines. These are of the 2-pole iron-clad type, with the fields cast in a single piece of cast steel.

ELMER G. WILLYOUNG & CO., 1210 Betz Building, Philadelphia, Pa., who, as we lately announced, are the sole American agents of Nalder Bros. & Co. and L. Oertling, of London, and James White, of Glasgow, Scotland, are meeting with much success in handling the standard measuring instruments made by these celebrated firms.

THE DEARBORN ELECTRIC COMPANY, 19 Quincy street, Chicago, Ill., in a compactly printed 128-page book, presents a very complete catalogue of general electrical supplies. The catalogue, which is the first of the kind issued by this firm, is well illustrated and includes among its contents an almost exhaustive variety of electric lighting and house goods.

CHAS. E. CHAPIN, 136 Liberty street, New York, manufacturer of the Perfection woven wire dynamo brush, has appointed Mr. Ernest W. Cooke as his agent for the sale of these brushes throughout the West. Mr. Cooke represents some six Eastern manufacturers in Chicago and is a well-known and popular salesman. The peculiarity of the Perfection wire brush is in the winding of the cloth, which binds the wires at the end and this makes a brush that requires no solder or stitching on the body or on the portion that comes in contact with the commutator.

SAMUEL W. RUSHMORE, 126 Liberty street, New York, has secured a contract from the Gettysburg Electric Railway Company, whose handsome power house was lately destroyed by fire, to rebuild the entire electrical plant. The new plant will consist of the two 150-kw generators, two 60-light arc machines, and two 1,200-light alternators driven by three 200-hp Frick-Corliss engines. The switchboard to be built by the Rushmore Works will be of white marble, and one of the most elaborate of its kind in the country. The building is to be of brown stone, and it is intended to make the plant the finest of its size in Pennsylvania.

Business Notices.

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me., are the patentees and manufacturers of the best woven wire commutator brush on the market.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

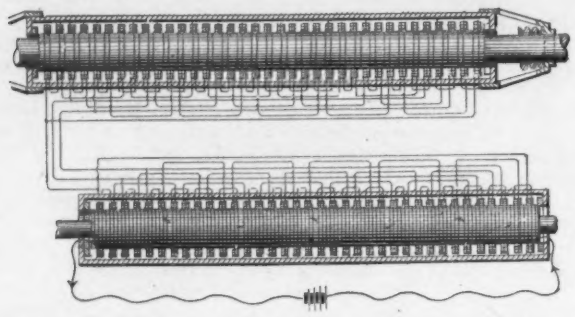
Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 15, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

532,441. SYSTEM OF POWER TRANSMISSION; C. S. Bradley, Avon, N. Y. Application filed September 22, 1893. This comprises a multipolar reciprocatory generator provided with a polyphase winding on its armature and normally charged field-magnet, and a multipolar polyphase reciprocatory motor in circuit with the generator.

532,448. CONDUIT RAILWAY TROLLEY: W. T. Dulany, Jr., New York, N. Y. Application filed March 30, 1894. This comprises a trolley standard having plate conductors, insulators and plates inclosing them, and extending downward beyond the conductors, with a conduit cleaning brush having its back secured to the lower end of the plates between them.



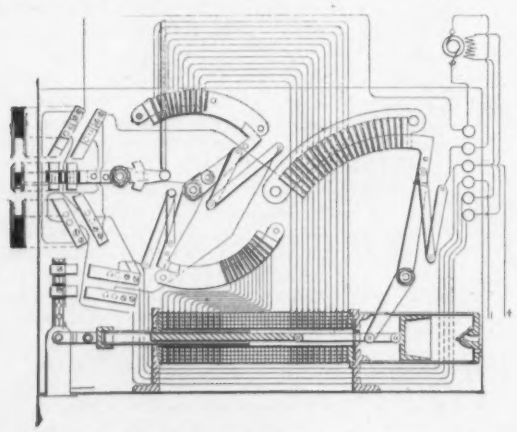
No. 532,441.—System of Power Transmission.

32,449. CONDUIT ELECTRIC RAILWAY: W. T. Dulany, Jr., New York, N. Y. Application filed August 16, 1894. An underground trolley standard having two conductors, insulating material separating and inclosing the same, front and rear bars, side plates and wearing plates secured to the bars, each conductor consisting of two upper and lower plates apart from each other, and a fuse cut off uniting the plates on a lower level than the wearing plates.

32,468. CARBON FILAMENT AND METHOD OF MANUFACTURING SAME: A. D. Little, Boston, Mass. Application filed June 18, 1894. A material for carbon filaments consisting of cellulose and an organic acid.

532,477. TROLLEY CATCHER; M. V. Nichols and J. A. Fraser, Port Arthur, Canada. Application filed May 26, 1894. This comprises a guide way on the cars, a weight sliding vertically thereon, a flexible connection between the weight and trolley pole, a detent for holding the weight elevated, having an unlocking means connected with the pole, and arranged to be operated by the upward movement of the trolley arm to release the detent from the weight.

532,514. ELECTRIC ELEVATOR AND MOTOR CONTROLLER: R. Wilson, Louisville, Ky. Application filed June 23, 1894. A controlling device for electric motors consisting of a solenoid having two movable cores, one acting upon the main switch to start and stop the motor, and the other operating a speed controlling device such as a retostate.



No. 532,514.—Electric Elevator and Motor Controller.

532,531. ELECTRIC ARC LAMP: A. Chester and J. J. Rathbone, London, England. Application filed March 26, 1984. This comprises a rocking armature with a swinging carriage, a roller pivoted to the carriage, and inclined stop fixed to the base of the lamp in the swinging path of the roller a spring attached to one end of the armature, which, in conjunction with the stop, causing the roller to move the carbons asunder.

532,537. AUTOMATIC CIRCUIT BREAKER; H. P. Davis, Pittsburgh, Pa. Application filed February 28, 1894. This comprises a magnetic sustainer and armature npheld thereby; in combination with a stop adapted to be swung under the armature, and to swing away therefrom when the armature is drawn fully into place by the magnet.

532,538. CONTROLLER FOR ELECTRIC CARS. H. P. Davis, Pittsburgh, Pa. Application filed April 14, 1894. This comprises a switch, a handle removable therefrom only when in a certain position relative to the switch, and means for preventing occurrence of the relative position of the handle and switch, save when the switch is one predetermined position.

532,549. ALTERNATING CURRENT MOTOR. L. Gutman, Pittsburgh, Pa. Application filed August 27, 1890. The method of reducing self induction in an armature, which consists in producing two alternating fields of the same phase, rotating an armature coil, one part under the influence of the field, and another part under the influence of the other field, so that the one part will cut a maximum number of lines of force, while the other part is cutting a minimum.

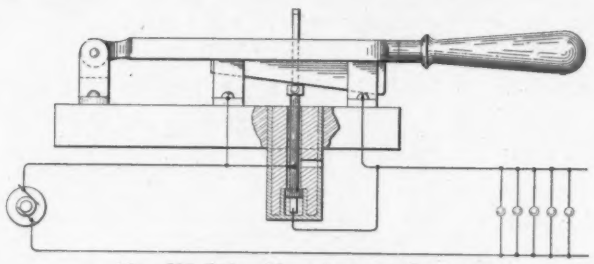
532,559. GALVANOMETER; A. H. Hoyt, Penacock, N. H. Application filed April 2, 1894. The combination with a solenoid of a movable armature or needle, comprising a thin plate of soft iron pivotally supported within the solenoid on an axis parallel to its own plane, and perpendicular to the axis of the solenoid.

532,560. GALVANOMETER; A. H. Hoyt, Penacock, N. H. Application filed April 25, 1894. This comprises an electrically moved needle, and a pivotally supported pointer or indicator, with a link connected at one end to the needle and at the other end to an arm connected to the pointer.

532,561. GALVANOMETER; A. H. Hoyt, Penacock, N. H. Application filed April 25, 1894. This comprises two solenoids, a common armature pivoted at right angles to the coils, the polar extremities thereof extending into the mouths of the coils respectively, and means for indicating the amount of current in either solenoid by the inductive effect thereof on the armature.

532,576. CLOSED CONDUIT ELECTRIC RAILWAY; G. W. McClintock, Wollaston, and D. J. McLane, Quincy, Mass. Application filed July 2, 1894. This comprises a sectional conductor rail, a feeder, a trolley rail having sections corresponding with the sections of the conductor rail, and switch levers for connecting the branches of the feeder with the sections of the conductor rail when the trolley rail is depressed.

532 590. CLOSED CONDUIT ELECTRIC RAILWAY; J. Schnepf, New York, N. Y. Application filed September 9, 1893. This comprises a continuous main conducor composed of interlocking links and plates upon the conduit against which the conductor is adapted to be drawn magnetically.



No. 532,594.—Non-Arcing Switch.

532,593. CONVERTER SYSTEM FOR ELECTRIC RAILWAYS; C. F. Scott, Pittsburgh, Pa. Application filed July 31, 1893. This comprises an alternating circuit, a working converter, a choke coil in series with the primary thereof, and a normally open short circuit around the choke coil, a bridge for closing the short circuit, and electrical means for operating the bridge in series with one of the coils of the working conductor, the choking coils being so proporticned as to be unsaturated when the secondary is open and saturated when it is closed under normal conditions.

537,594. NON-ARCING SWITCH; C. F. Scott and H. P. Davis, Pittsburgh, Pa., Application filed March 29, 1894. This comprises a main switch, a pair of separable shunts in contact therewith, in combination with a restricted chamber wherein one or more of the contacts is adapted to move, and a vent communicating with the interior of the chamber.

552 633. RAILWAY BLOCK SIGNAL; W. Berrigan and W. H. McClure, Elmira, N. Y. Application filed September 18, 1894. This comprises separate circuits for each block, pitmen connected with the semaphores, levers connected to the pitmen, track instruments actuating the levers, stops on the pitmen detents automatically engaging the stops to retain the semaphores set to danger, magnets at the semaphores, armatures drawing the detents out of engagement by energy of the magnets, and circuit closers at each semaphore in circuit with the magnets at the next semaphore at the rear, and actuated by the pitmen.

532 662. ELECTRIC SWITCH: W. P. Hancock, Everet, Mass. Application filed November 27, 1894. This comprises a pivoted U-shaped carrier having slots in its sides, and oppositely extending horizontal pins, a pivoted blade within the carrier provided with horizontal pins projecting through the slots of the carrier, external springs flanking the carrier and extending between the two sets of pins, pivoted contact blades, and stationary magnets engaged by the blades.

532,666. SURGICAL INSTRUMENT.: E. E. Johnson, Denison, Tex. Application filed September, 28, 1894. This comprises a tube having guides therein and holes, and a frame consisting of two parallel members adapted to enter the tube and move between the guides, and lugs on each of the members adapted to cover and uncover the holes.

532 678. MECHANICAL TOY; A. Martin, London, England. Application filed October 15, 1894. In a toy, a magnetized spindle vertically mounted and provided with a fly-wheel, in combination with a quadrant rack and pinion gear for imparting motion to the spindle and fly-wheel.

532,742. MAGNETIC SEPARATOR; H. Arden, Seattle, Washington. Applictaion filed August 15, 1894. The combination of a hopper, an outlet through which may fall a stream of sand, and a magnet having a trough, the magnet being alternately magnetized and demagnetized by a current of electricity passed through and shut off from the same.